EPA/ROD/R08-90/028
1990

EPA Superfund
Record of Decision:

WHITEWOOD CREEK
EPA ID: SDD980717136
OU 01
WHITEWOOD, SD
03/30/1990

250,000) QUADRANGLE AT A LATITUDE OF 44 DEGREES - 45 DEGREES NORTH AND LONGITUDE 102 DEGREES - 104 DEGREES WEST.

THE WHETTED CREEK SITE, A MINE TAILINGS CONTAMINATED SITE, ENCOMPASSES APPROXIMATELY 2,018 ACRES ALONG 18 MILES OF WHETTED CREEK FLOODPLAIN FROM THE CROOK CITY BRIDGE TO THE CONFLUENCE WITH THE BELLE FOURCHE RIVER. FROM THE 1870S TO 1977, TAILINGS WERE DISCHARGED INTO WHETTED CREEK FROM UPSTREAM GOLD MINING AND MILLING OPERATIONS. THESE TAILINGS WERE DEPOSITED ALONG THE FLOODPLAINS OF WHETTED CREEK AND THE BELLE FOURCHE AND CHEYENNE RIVERS.

THE PRIMARY CONCERNS FOR POTENTIAL HARM TO HUMAN HEALTH AND THE ENVIRONMENT PRESENTED BY THE SITE ARE EXPOSURE TO ARSENIC-RICH TAILINGS DEPOSITS, AND ALLUVIAL SOIL, RESIDENTIAL SOIL, AND ALLUVIAL GROUNDWATER CONTAMINATED WITH ARSENIC.

THE DOMINANT LAND USE WITHIN THE SITE IS WOODLANDS. THE REMAINING LAND WITHIN THE SITE IS USED FOR AGRICULTURE AND RESIDENCES. THE AGRICULTURAL LANDS ARE LOCATED IN SOMEWHAT DISCONTINUOUS SECTIONS ALONG THE EDGE OF THE FLOODPLAIN IN AREAS ADJOINING AND OCCASIONALLY OVERLAPPING THE TAILINGS DEPOSIT AREAS.

THE RESIDENCES ARE SCATTERED ALONG BOTH SIDES OF WHETTED CREEK. BASED ON 1988 DATA, 22 HOUSEHOLDS AND FIVE VACANT RESIDENTIAL PROPERTIES ARE SITUATED WITHIN OR IN CLOSE PROXIMITY TO THE SITE WITH A POPULATION TOTALING 85 (63 ADULTS AND 22 CHILDREN). EIGHTY HOUSEHOLDS, WITH A POPULATION OF 283, ARE WITHIN A MILE OF THE SITE ON EITHER SIDE OF THE CREEK AND 168 HOUSEHOLDS, WITH A POPULATION OF 647, EXIST WITHIN THREE MILES OF THE SITE. THE TOWN OF WHETTED, LOCATED ABOUT ONE MILE WEST OF THE SITE, HAS A POPULATION OF 821.FIGURE A-1

#SHEA

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

HISTORY OF OPERATIONS

1877 TO 1977. THE HOMESTAKE MINING COMPANY, LOCATED IN LEAD, SOUTH DAKOTA, BEGAN GOLD MINING OPERATIONS IN THE WHETTED CREEK WATERSHED IN THE LATE 1870S, FOLLOWING DEVELOPMENT OF GOLD DEPOSITS DISCOVERED PRIOR TO 1850. MINING OPERATIONS OVER THE LAST CENTURY HAVE PRODUCED ABOUT ONE BILLION TONS OF ORE FROM BOTH OPEN PIT AND SUBSURFACE SHAFTS WHICH CURRENTLY EXTEND TO A DEPTH EXCEEDING 8,000 FEET BELOW THE SURFACE. THE PROCESSING OF THE ORES HAS CHANGED OVER THE YEARS, RESULTING IN CHANGES IN THE CHARACTERISTICS OF THE WASTE STREAM. METHODS HAVE BECOME PROGRESSIVELY MORE EFFICIENT, SO THAT EARLIER TAILINGS WERE COARSER AND CONTAINED MORE METAL THAN THOSE RESULTING FROM PRESENT OPERATIONS.

THE FIRST MILLING METHODS WERE PRIMITIVE AND NON-MECHANIZED. GOLD WAS RECOVERED BY GRAVITY OR BY AMALGAMATION WITH MERCURY. BY 1880, THE EARLY CRUDE METHODS OF MILLING WERE REPLACED WITH MORE THAN 1,000 STAMP MILLS WHICH CRUSHED THE ORE TO A COARSE SAND SIZE. THE TAILINGS WERE THEN DISCHARGED TO WHETTED CREEK OR ITS TRIBUTARIES. PRIOR TO THE TURN OF THE CENTURY, MUCH OF THE ORE CONSISTED OF RED-COLORED MINERALS WHICH WERE THE NEAR SURFACE RESIDUAL OXIDATION PRODUCTS OF THE ORIGINAL UNOXIDIZED ORE BODIES.

AFTER THE TURN OF THE CENTURY, THE BLACK AND GREEN-COLORED REDUCED ORES FROM DEEPER IN THE MINE, BELOW THE ZONE OF OXIDATION, WERE THE FOCUS OF MINING ACTIVITY. THE USE OF BALL AND ROD MILLS, BROUGHT INTO SERVICE IN THE 1920S, CREATED FINER-GRAINED TAILINGS REFERRED TO AS "SLIMES." AFTER 1935, MUCH OF THE SAND-SIZED PORTION OF THE TAILINGS WAS RETURNED TO THE MINE TO BACKFILL MINED AREAS. THE "SLIMES" AS WELL AS SOME COARSE-GRAINED SANDS CONTINUED TO BE DISCHARGED DIRECTLY INTO WHETTED CREEK UNTIL 1977, WITH THE EXCEPTION OF FIVE YEARS DURING WORLD WAR II WHEN THE MINE WAS CLOSED. MERCURY AMALGAMATION WAS DISCONTINUED IN 1970.

TAILINGS, CONSISTING OF FINELY GROUND ROCK, RESIDUAL METALLIC AND NONMETALLIC COMPOUNDS NOT EXTRACTED FROM THE ORE, AND TRACE COMPOUNDS USED IN THE EXTRACTIVE PROCESSES, WERE TRANSPORTED AWAY FROM THE MINE BY THE WATER OF WHETTED CREEK. THESE TAILINGS WERE DEPOSITED DOWNSTREAM FROM THE MINE WITH THE LARGEST DEPOSITS ALONG THE BANKS OF WHETTED CREEK BETWEEN THE CROOK CITY BRIDGE AND THE CONFLUENCE WITH THE BELLE FOURCHE RIVER. THE TAILINGS REMAIN ALONG MUCH OF THIS REACH OF WHETTED CREEK AND CONTINUE TO LEACH METALS TO SURFACE AND SUBSURFACE WATERS.

1977 TO PRESENT. PRESENTLY ORE IS MILLED IN CRUSHERS AND ROD AND BALL MILLS. THE MATERIAL FROM THE MILLING PROCESS IS SEPARATED INTO TWO SIZE FRACTIONS, SAND AND SLIMES. THESE FRACTIONS ARE

TREATED SEPARATELY BY CYANIDE LEACH AND CARBON FILTER METHODS. RESIDUAL SAND MATERIAL IS USED TO BACKFILL WITHIN THE MINE. RESIDUAL SLIMES AND PROCESS WATERS ARE PIPED TO THE GRIZZLY GULCH TAILINGS IMPOUNDMENT IN THE UPPER REACHES OF THE WHETTED CREEK WATERSHED.

A WASTEWATER TREATMENT PLANT NOW TREATS WATER FROM THE TAILINGS IMPOUNDMENT AND THE MINE. THIS PLANT UTILIZES ROTATING BIOLOGICAL CONTACTORS TO REMOVE CYANIDE AND AMMONIA; IRON PRECIPITATION AND SORPTION TO REMOVE METALS; AND SAND FILTRATION TO REMOVE SUSPENDED SOLIDS. SOLIDS ARE RETURNED TO THE TAILINGS POND. WATER ENTERS GOLD RUN CREEK WHICH DISCHARGES INTO WHETTED CREEK BETWEEN THE TOWNS OF LEAD AND DEADWOOD. THIS DISCHARGE IS MONITORED TO MEET REQUIREMENTS OF THE CLEAN WATER ACT.

HISTORY OF SITE INVESTIGATIONS

THE FIRST SYSTEMATIC STUDIES OF THE WHITEWOOD CREEK AREA WERE UNDERTAKEN BY THE SOUTH DAKOTA DEPARTMENT OF HEALTH IN 1960. THIS WORK QUANTIFIED THE SOLIDS AND CYANIDE LOADING TO WHITEWOOD CREEK, RECOMMENDED FURTHER STUDY, AND REPORTED THAT A COMPREHENSIVE WATER POLLUTION CONTROL PROGRAM WAS NEEDED, IF ANY BENEFICIAL USE WAS TO BE MADE OF WHITEWOOD CREEK. A STUDY BY THE SOUTH DAKOTA DEPARTMENT OF GAME, FISH AND PARKS IN 1965 DETERMINED THAT AQUATIC BOTTOM ORGANISMS WERE NOT PRESENT IN WHITEWOOD CREEK DOWNSTREAM FROM THE WASTE DISCHARGES. IN 1970-71, A SERIES OF STUDIES BY THE US ENVIRONMENTAL PROTECTION AGENCY (EPA) AND THE US FOOD AND DRUG ADMINISTRATION (FDA) WERE UNDERTAKEN TO DOCUMENT AND CHARACTERIZE THE DISCHARGE OF TAILINGS TO WHITEWOOD CREEK AND TO DETERMINE THE MAGNITUDE AND EXTENT OF THE RESULTANT POLLUTION. THESE STUDIES, TOGETHER WITH ONE PREPARED BY THE UNIVERSITY OF SOUTH DAKOTA, FOCUSED ON THE POSSIBLE SERIOUS ENVIRONMENTAL HAZARD CREATED BY MERCURY CONTAMINATION. IN DECEMBER 1970, RESULTS OF THESE STUDIES LED TO THE DISCONTINUANCE OF MERCURY IN GOLD RECOVERY OPERATIONS.

IN THE WINTER OF 1974-75, ABOUT 50 HOLSTEIN CATTLE THAT WERE PART OF A DAIRY OPERATION LOCATED ADJACENT TO WHITEWOOD CREEK, DIED OF UNKNOWN CAUSES. LATER, A STUDY BY THE SOUTH DAKOTA STATE UNIVERSITY DEPARTMENT OF VETERINARY SCIENCE CONCLUDED THAT THE CATTLE HAD DIED OF ARSENIC TOXICOSIS DUE TO CONSUMPTION OF CORN SILAGE THAT HAD BEEN CONTAMINATED BY THE ACCIDENTAL INCORPORATION OF MINING WASTES WITH FODDER DURING SILO-FILLING OPERATIONS. A JOINT STUDY, CONDUCTED BY THE SOUTH DAKOTA GEOLOGICAL SURVEY AND WATER RESOURCES DIVISION BETWEEN MAY 1975 AND JULY 1978, INVESTIGATED THE PRESENCE OF ARSENIC IN SURFACE AND GROUNDWATERS ALONG WHITEWOOD CREEK AND THE BELLE FOURCHE RIVER AND PORTIONS OF THE CHEYENNE RIVER. THIS STUDY, PUBLISHED IN 1978, FOUND ARSENIC CONCENTRATIONS RANGING FROM 2.5 TO 1,530 UG/L IN GROUNDWATER FROM AREAS WITH LARGE TAILINGS DEPOSITS.

ONE COMMON CONCLUSION OF ALL THESE POLLUTION INVESTIGATIONS WAS THAT WHITEWOOD CREEK WOULD REMAIN HIGHLY CONTAMINATED UNTIL THE DISCHARGE OF TAILINGS WAS DISCONTINUED. TO COMPLY WITH NEW ENVIRONMENTAL LAWS, INCLUDING THE ORE MINING AND DRESSING EFFLUENT GUIDELINES, HOMESTAKE MINING COMPANY IMPLEMENTED THE GRIZZLY GULCH TAILINGS DISPOSAL PROJECT, AN IMPOUNDMENT AREA FOR TAILINGS STORAGE. THE TAILINGS DISPOSAL SYSTEM BECAME OPERATIONAL ON DECEMBER 1, 1977, AND NO DISCHARGE OF TAILINGS TO WHITEWOOD CREEK HAS OCCURRED SINCE THEN.

IN 1981, AT THE REQUEST OF THE GOVERNOR OF SOUTH DAKOTA, THE WHITEWOOD CREEK SITE WAS PLACED ON THE "INTERIM NATIONAL PRIORITIES LIST." SUBSEQUENTLY, ON SEPTEMBER 8, 1983, THE SITE WAS PLACED ON THE NATIONAL PRIORITIES LIST (NPL).

FOLLOWING THE INITIAL PLACEMENT OF THE SITE ON THE INTERIM NATIONAL PRIORITIES LIST, EPA, THE SOUTH DAKOTA DEPARTMENT OF WATER AND NATURAL RESOURCES (DWNR), AND HOMESTAKE MINING COMPANY (HOMESTAKE) ENTERED INTO A THREE-PARTY STUDY AGREEMENT IN 1982 TO CONDUCT A COMPREHENSIVE STUDY OF THE SITE. THE STUDY, FUNDED BY HOMESTAKE AND CONDUCTED BY FOX CONSULTANTS, INC. OF DENVER, COLORADO, WAS SUPERVISED BY A PROJECT ADVISORY COMMITTEE COMPOSED OF REPRESENTATIVES OF EACH OF THE THREE PARTIES. THE FOX STUDY INVESTIGATED THE QUALITY OF SURFACE WATERS, GROUNDWATERS, SOILS, SEDIMENTS AQUATIC LIFE AND VEGETATION IN THE STUDY AREA, ON AN 18 MILE SEGMENT OF THE FLOODPLAIN OF WHITEWOOD CREEK ABOVE ITS CONFLUENCE WITH THE BELLE FOURCHE RIVER. THE STUDY USED 14 TARGET SUBSTANCES AS INDICATORS OF POTENTIAL PUBLIC HEALTH AND ENVIRONMENTAL THREAT. THE CONCLUSIONS, PUBLISHED IN A MULTI-VOLUME REPORT IN DECEMBER 1984, INDICATED THAT ARSENIC WAS THE CONTAMINANT OF MOST SIGNIFICANT ENVIRONMENTAL CONCERN THROUGHOUT THE MEDIA UNDER EVALUATION.

THE REPORT ALSO INDICATED THAT, ALTHOUGH MERCURY AND CYANIDE HAD ORIGINALLY BEEN CONTAMINANTS OF CONCERN IN TAILINGS DISCHARGED FROM HOMESTAKE MINE, CONCENTRATIONS OF THESE CONTAMINANTS AT THE WHITEWOOD CREEK SUPERFUND SITE WERE NEAR BACKGROUND LEVELS AND THEREFORE NOT OF ENVIRONMENTAL

CONCERN AT THIS TIME.

SIMULTANEOUSLY WITH THE FOX STUDY, TWO RELATED STUDIES WERE CONDUCTED. HOMESTAKE ASSEMBLED A GROUP OF CONSULTANTS LED BY J.A. CHERRY TO ASSIST THE PROJECT ADVISORY COMMITTEE. THESE CONSULTANTS STUDIED THE HYDROGEOCHEMISTRY OF THE SITE AND PREPARED A REPORT COMPLETED IN 1985. THIS REPORT, TITLED "HYDROGEOCHEMISTRY OF SULFIDE AND ARSENIC-RICH TAILINGS AND ALLUVIUM ALONG WHITEWOOD CREEK, SOUTH DAKOTA" WAS PUBLISHED IN 1986 IN MINERAL AND ENERGY RESOURCES. THE SECOND STUDY, AN EXTENSIVE INVESTIGATION OF THE SURFACE WATER IN WHITEWOOD CREEK, WAS INITIATED IN 1982 BY HYDROLOGISTS FROM THE US GEOLOGICAL SURVEY. THE US GEOLOGICAL SURVEY PUBLISHED A DRAFT REPORT IN 1985. SUBSEQUENT PUBLISHED REPORTS AND UNPUBLISHED DATA ARE CURRENTLY AVAILABLE FROM THE US GEOLOGICAL SURVEY.

HOMESTAKE AND THE STATE OF SOUTH DAKOTA SUBMITTED A REQUEST TO EPA IN 1983 TO INITIATE PROCEEDINGS TO DELETE WHITEWOOD CREEK FROM THE NPL, AND RESUBMITTED THE REQUEST IN 1985. THIS REQUEST WAS SUPPORTED BY A HUMAN HEALTH EXPOSURE ASSESSMENT PERFORMED BY HOMESTAKE'S CONTRACTOR, ENVIRON CORPORATION, WHICH CONCLUDED THAT THE SITE POSED NO RISK TO HUMAN HEALTH. EPA, BELIEVING THAT IT WAS PREMATURE TO DISCUSS DELETION UNTIL THE STUDIES WERE COMPLETED, DID NOT PURSUE DELISTING FURTHER.

HOMESTAKE ALSO FUNDED SEVERAL ADDITIONAL STUDIES WHICH INCLUDED: 1) AN EVALUATION BY INDUSTRIAL WASTE MANAGEMENT INC. OF THE WATER QUALITY SAMPLING RESULTS COLLECTED BY THE US GEOLOGICAL SURVEY IN WHITEWOOD CREEK BEFORE AND AFTER THE INSTALLATION OF THE WASTEWATER TREATMENT SYSTEM UPSTREAM FROM THE CERCLA SITE; 2) AN ANALYSIS OF THE AGE OF TREES GROWING ON THE TAILINGS DEPOSITS ALONG WHITEWOOD CREEK (FOR THE PURPOSE OF DATING THESE DEPOSITS) CONDUCTED BY POPE AND TALBOT, LAND FORESTER; 3) AN ASSESSMENT OF THE SOURCES, OCCURRENCES AND MOBILITY OF SELENIUM IN THE WHITEWOOD CREEK BASIN AND A RE-ANALYSIS OF THE SELENIUM CONCENTRATIONS IN EXISTING WATER SUPPLY WELLS ALONG WHITEWOOD CREEK, BOTH PERFORMED BY GEOCHEMICAL ENGINEERING INC. ANOTHER STUDY BY GEOCHEMICAL ENGINEERING INC. IN OCTOBER 1988, INCORPORATED ADDITIONAL GROUNDWATER QUALITY DATA AND SOIL CHARACTERIZATION DATA. FOR THIS STUDY, THE POPULATION RESIDING WITHIN THE SITE WAS INTERVIEWED REGARDING THEIR HABITS WITH RESPECT TO THE INTAKE OF DRINKING WATER AND LOCALLY GROWN FOOD CROPS. THE STUDY INCLUDED TESTING OF WATER SUPPLY WELLS.

IN DECEMBER 1988, AN ADMINISTRATIVE ORDER ON CONSENT WAS SIGNED BY EPA AND THE HOMESTAKE MINING CO. THIS ORDER CONCLUDED THAT THE FOX STUDY CONSTITUTED THE FUNCTIONAL EQUIVALENT OF A REMEDIAL INVESTIGATION, AS PRESCRIBED BY THE NATIONAL CONTINGENCY PLAN. THE ORDER REQUIRED THAT HOMESTAKE CONDUCT A FEASIBILITY STUDY (FS) IN ORDER TO IDENTIFY AND EVALUATE ALTERNATIVES FOR THE APPROPRIATE EXTENT OF REMEDIAL ACTION TO PREVENT OR MITIGATE THE MIGRATION, RELEASE OR THREATENED RELEASE OF HAZARDOUS SUBSTANCES, POLLUTANTS OR CONTAMINANTS FROM THE SITE.

IN 1989, AN FS WAS CONDUCTED BY ICF TECHNOLOGY INC. ON BEHALF OF HOMESTAKE. SOIL DATA COLLECTED IN MAY, JUNE AND JULY 1989 BY HOMESTAKE AND ANALYZED BY GEOCHEMICAL ENGINEERING INC. WAS INCORPORATED INTO THIS STUDY, ALONG WITH A REPORT PREPARED BY MORRISON KNUDSEN ENGINEERS, ON THE FEASIBILITY OF REMOVING TAILINGS.

REMEDIAL ACTION OBJECTIVES FOR THE FS WERE BASED ON EPA'S ENDANGERMENT ASSESSMENT. EPA CONTRACTED WITH BATTELLE PACIFIC NORTHWEST LABORATORY TO PERFORM AN ENDANGERMENT ASSESSMENT. THE FIRST DRAFT WAS RELEASED IN JANUARY 1988 AND COMMENTS WERE PROVIDED BY HOMESTAKE IN APRIL 1988. A SECOND DRAFT WAS RELEASED BY EPA IN MARCH 1989 AND COMMENTED ON BY HOMESTAKE IN JUNE 1989. IN JULY 1989, EPA, WITH THE ASSISTANCE OF JACOBS ENGINEERING, RELEASED A FINAL ENDANGERMENT ASSESSMENT FOR THE SITE.

THE CONCLUSIONS OF THE RI/FS AND THE EA WERE THAT 1) ALTHOUGH THE TAILINGS DEPOSITS CONTAINED HIGH CONCENTRATIONS OF ARSENIC, SO LONG AS THE SITE RESIDENT DOES NOT SPEND SIGNIFICANT AMOUNTS OF TIME IN THE TAILINGS DEPOSITS AREAS, THE RISK TO THAT INDIVIDUAL FROM THE TAILINGS IS MINIMAL. SOME RESIDENTIAL AREAS AND IRRIGATED CROPLAND DO CONTAIN CONCENTRATIONS OF ARSENIC WHICH PRESENT HEALTH RISKS TO PEOPLE LIVING AND WORKING IN THESE AREAS BECAUSE OF THE LARGE AMOUNT OF TIME THE INDIVIDUALS ARE EXPOSED TO ARSENIC OVER THEIR LIFETIME, 2) INGESTION OF CONTAMINATED GROUNDWATER COULD PRESENT A RISK TO HUMAN HEALTH, BUT THAT THIS RISK COULD BE ELIMINATED IF CONSUMPTION OF CONTAMINATED GROUNDWATER WERE NOT ALLOWED, 3) THE SURFACE WATER OF WHITEWOOD CREEK IS BEING IMPACTED BY THE TAILINGS DEPOSITS BUT, ALTHOUGH THE CONCENTRATION OF ARSENIC IN THE STREAM OCCASIONALLY EXCEEDS SOME APPROPRIATE STANDARDS, IT IS WITHIN THE RANGES SPECIFIED BY APPLICABLE STANDARDS.

HISTORY OF ENFORCEMENT ACTIONS

EPA SENT A NOTICE LETTER TO HOMESTAKE IN 1981 NOTIFYING THEM OF POTENTIAL LIABILITY AT WHITEWOOD CREEK AND REQUESTING INFORMATION ABOUT THEIR ACTIVITIES. EARLY IN 1982, EPA, THE STATE AND HOMESTAKE BEGAN NEGOTIATIONS FOR HOMESTAKE TO PERFORM NECESSARY STUDIES. ON AUGUST 11, 1982, EPA, SOUTH DAKOTA AND HOMESTAKE COMPLETED THESE NEGOTIATIONS AND SIGNED A MEMORANDUM OF UNDERSTANDING AMONG THE THREE PARTIES TO CONDUCT A STUDY OF THE WHITEWOOD CREEK AREA.

IN SEPTEMBER 1988, A SPECIAL NOTICE LETTER WAS SENT TO THE HOMESTAKE MINING COMPANY AND TO GOLDSTAKE EXPLORATIONS, INC., INFORMING THEM THAT BOTH COMPANIES WERE POTENTIALLY RESPONSIBLE PARTIES FOR CLEANUP OF THE SITE. THE NOTICE LETTER GAVE BOTH PARTIES THE OPPORTUNITY TO CONDUCT THE FEASIBILITY STUDY. GOLDSTAKE ELECTED NOT TO PARTICIPATE IN THE FS STUDIES. AS MENTIONED ABOVE, AN ADMINISTRATIVE ORDER ON CONSENT WAS SIGNED IN DECEMBER 1988 BY EPA AND HOMESTAKE REQUIRING HOMESTAKE TO CONDUCT AN FS FOR THIS SITE.

#HCP
III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

BASED UPON NOMINATION BY THE STATE OF SOUTH DAKOTA, THE WHITEWOOD CREEK SITE WAS PROPOSED FOR LISTING ON THE NATIONAL PRIORITIES LIST (NPL) OF HAZARDOUS WASTE SITES IN 1981 AND FINALIZED ON SEPTEMBER 8, 1983. IN AUGUST AND OCTOBER 1985, EPA CONDUCTED INTERVIEWS WITH REPRESENTATIVES FROM THE DWNR, THE SIERRA CLUB, THE RAPID CITY JOURNAL, HOMESTAKE AND CONCERNED CITIZENS, IN ORDER TO GAIN AN UNDERSTANDING OF THE PUBLIC'S CONCERNS AND ATTITUDES ABOUT THE SITE. BASED ON THESE INTERVIEWS, CONCERN ABOUT THE SITE WAS DETERMINED TO BE FAIRLY LOW. THIS LOW CONCERN WAS ATTRIBUTED TO: A) HOMESTAKE HAVING INVESTED TIME AND MONEY TOWARDS RESOLVING CONTAMINATION ISSUES AND HAVING MADE SUBSTANTIAL PROGRESS IN CLEANING UP THE CREEK; B) THE RETURN OF FISH TO WHITEWOOD CREEK, A ONCE-DEAD STREAM; AND C) LOCAL PERCEPTION THAT THE SITE'S PROBLEMS WERE MINOR COMPARED TO OTHER SUPERFUND SITES ACROSS THE COUNTRY.

THE RESULTS OF THESE INTERVIEWS WERE USED BY EPA TO DEVELOP A COMMUNITY RELATIONS PLAN FOR THE SITE. ALSO IN DECEMBER 1985, EPA PREPARED A MAILING LIST AND SENT LETTERS TO PROPERTY OWNERS LOCATED NEAR MONITORING WELLS ALONG THE CREEK, INFORMING THEM OF EPA COMMUNITY RELATIONS POLICIES AND REQUESTING THEIR INPUT INTO THE DEVELOPMENT OF THE COMMUNITY RELATIONS PLAN. THE PLAN WAS COMPLETED IN APRIL 1986 AND PLACED IN FOUR REPOSITORIES ESTABLISHED IN RAPID CITY, BROOKINGS, DEADWOOD AND PIERRE, SOUTH DAKOTA. IN MAY 1986, EPA PREPARED AND DISTRIBUTED TO PERSONS ON THE SITE MAILING LIST, A FACT SHEET DESCRIBING THE SUPERFUND PROGRAM AND HOW IT RELATES TO THE WHITEWOOD CREEK SITE.

DURING 1988 AND 1989, EPA HELD SEVERAL MEETINGS WITH PROPERTY OWNERS, ELECTED OFFICIALS AND GOVERNMENTAL AGENCIES. IN MAY AND SEPTEMBER 1988, EPA MET WITH PROPERTY OWNERS LIVING AT OR NEAR THE SITE AND WITH THE CENTENNIAL VALLEY MAYOR'S ASSOCIATION, IN ORDER TO DISCUSS THE STATUS OF SITE ACTIVITIES AND TO HEAR ANY CONCERNS ABOUT THE SITE. THE PROPERTY OWNERS EXPRESSED CONCERN ABOUT THE HEALTH OF THEIR CHILDREN AND LIVESTOCK AND ABOUT THE USE OF CROPLANDS NEAR THE SITE. IN ADDITION TO THESE CONCERNS, THE MAYOR'S ASSOCIATION EXPRESSED CONCERN ABOUT THE EFFECT OF THE SUPERFUND STATUS OF THIS SITE ON THE MINING INDUSTRY, SINCE THE LOCAL ECONOMY IS SOMEWHAT DEPENDENT ON THIS INDUSTRY.

IN NOVEMBER 1988, EPA MET WITH STATE LEGISLATORS IN PIERRE, SOUTH DAKOTA TO DISCUSS COMMUNITY CONCERNS IN THE WHITEWOOD AREA. THE MAJOR CONCERN EXPRESSED DURING THESE MEETINGS WAS THE EFFECT OF THE SITE ON THE MINING INDUSTRY IN THE STATE.

IN SEPTEMBER 1989, EPA MET WITH OFFICIALS FROM LOCAL MUNICIPALITIES AND FROM THE COUNTIES OF LAWRENCE, BUTTE AND MEADE, WHOSE JURISDICTION OVERLAPPED THE SITE AREA. THESE MEETINGS WERE HELD TO DISCUSS THE POSSIBILITY OF IMPLEMENTING REGULATORY CONTROLS SUCH AS ZONING RESTRICTIONS AS PART OF THE REMEDY AT THE SITE.

FOLLOWING COMPLETION OF THE FEASIBILITY STUDY, A PROPOSED PLAN FOR CLEANUP OF CONTAMINATION AT THE SITE WAS PREPARED BY EPA. THE ADMINISTRATIVE RECORD WAS ESTABLISHED ON JANUARY 5, 1990 AND COPIES PLACED ON FILE AT THE INFORMATION CENTER FOR THE SITE, THE LAWRENCE COUNTY REGISTRY OF DEEDS OFFICE IN LEAD, SOUTH DAKOTA. THE PROPOSED PLAN FACT SHEET WAS DISTRIBUTED TO PERSONS ON THE MAILING LIST ON JANUARY 10, 1990. PUBLIC NOTICES, PUBLISHED IN THE RAPID CITY JOURNAL ON JANUARY 8 AND JANUARY 14 AND THE BLACK HILLS NEWS ON JANUARY 10 ANNOUNCED THE CONCLUSION OF THE RI/FS AND AVAILABILITY OF THE PROPOSED PLAN FOR THE SITE; ESTABLISHED A PUBLIC COMMENT PERIOD

(FROM JANUARY 10 TO FEBRUARY 9, 1990) FOR SUBMITTING COMMENT ON THE PROPOSED PLAN; ANNOUNCED THE UPCOMING PUBLIC MEETING TO DESCRIBE THE FINDINGS OF THE RI/FS AND DISCUSS THE PROPOSED PLAN; AND ANNOUNCED THE AVAILABILITY OF THE SITE ADMINISTRATIVE RECORD FOR PUBLIC REVIEW. THE PUBLIC MEETING TO DISCUSS THE PROPOSED PLAN WAS HELD IN WHITEWOOD, SOUTH DAKOTA ON JANUARY 25, 1990. A RESPONSE TO COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD IS INCLUDED IN THE RESPONSIVENESS SUMMARY, ATTACHMENT B OF THIS RECORD OF DECISION.

#SC

IV. SITE CHARACTERISTICS

GEOLOGY AND HYDROLOGY

THIS SECTION PROVIDES GENERAL INFORMATION ABOUT THE WHITEWOOD CREEK DRAINAGE BASIN AND SETS THE STAGE FOR THE DETAILED DISCUSSION OF CONTAMINANT MIGRATION AND AFFECTED MEDIA WHICH FOLLOWS ON PAGE 14. FIGURES A-2 AND A-3 ARE SCHEMATIC REPRESENTATIONS OF THE GEOLOGIC AND HYDROLOGIC CONDITIONS AND CONTAMINATED MEDIA AT THE WHITEWOOD CREEK SUPERFUND SITE.

THE HEADWATERS OF WHITEWOOD CREEK ORIGINATE IN THE BLACK HILLS, WHICH ARE PREDOMINANTLY PRECAMBRIAN GRANITE AND SCHIST. THE SCHIST IS THE HOST ROCK FOR THE GOLD ORE AT THE HOMESTAKE MINE. THE GOLD IS FOUND IN VEINS COMPOSED OF QUARTZ AND IRON AND ARSENIC SULFIDE MINERALS. THE HOMESTAKE MINE IS IN LEAD, SOUTH DAKOTA, ABOUT SIX MILES UPSTREAM FROM THE WHITEWOOD CREEK SUPERFUND SITE. NORTH OF THE TOWN OF LEAD, THE BEDROCK LITHOLOGY CHANGES TO THICK-BEDDED LIMESTONE OF PALEOZOIC AGE. WHITEWOOD CREEK PASSES OVER THESE LIMESTONE BEDS AND ACROSS MESOZOIC SEDIMENTARY ROCKS CONTAINING SHALE AND GYPSUM, WITH SOME THIN SANDSTONE AND LIMESTONE BEDS.

WHITEWOOD CREEK WAS ORIGINALLY A SMALL MEANDERING STREAM WITH INSUFFICIENT CAPACITY TO TRANSPORT THE LARGE QUANTITIES OF TAILINGS DISCHARGED INTO IT BY VARIOUS MINING AND MILLING OPERATIONS PRIOR TO THE TURN OF THE CENTURY. THE DEPOSITED TAILINGS AND SOME ALLUVIAL MATERIAL SUBSEQUENTLY FILLED IN THE MEANDERS OF THE CREEK, AND THEREBY STRAIGHTENING ITS CHANNEL AND INCREASING ITS GRADIENT. THIS, IN TURN, CAUSED THE CREEK TO DOWNCUT ITS CHANNEL TO THE RESISTANT SHALE BEDROCK WHICH TODAY FORMS THE CHANNEL BOTTOM FOR MOST OF THE LENGTH OF THE EIGHTEEN-MILE STRETCH OF THE SUPERFUND SITE.

ALTHOUGH SOME TAILINGS DEPOSITS EXIST ABOVE AND BELOW THE SITE, THE LARGEST DEPOSITS OCCUR WITHIN THE SUPERFUND SITE, WHICH IS FROM THE CROOK CITY BRIDGE WHERE THE STREAM GRADIENT DECREASES AT THE EDGE OF THE BLACK HILLS, TO THE CONFLUENCE OF WHITEWOOD CREEK WITH THE BELLE FOURCHE RIVER. THE TAILINGS DEPOSITS AT THE SITE RANGE IN THICKNESS FROM LESS THAN ONE FOOT TO 15 FEET AND COVER AN AREA FROM 50 TO 300 FEET WIDE ON EITHER SIDE OF THE CREEK ACROSS THE SUPERFUND SITE.

REDDISH-BROWN TAILINGS FROM ORE MINED PRIOR TO THE TURN OF THE CENTURY MAKE UP THE MAJORITY OF THE DEPOSIT. GRAYISH-GREEN TAILINGS FROM ORE MINED LATER ARE ALSO PRESENT. BOTH TYPES OF TAILINGS MAY BE INTERBEDDED WITH THE NATURAL ALLUVIUM. THE NATURAL ALLUVIUM CONSISTS OF SANDY TO SANDY SILT MATERIALS WITH VARIABLE AMOUNTS OF INTERMIXED TAILINGS. THE ALLUVIUM GENERALLY IS LESS THAN 30 FEET THICK, AND INCREASES IN THICKNESS AND LATERAL EXTENT DOWNSTREAM THROUGH THE STUDY AREA. UPLAND ALLUVIAL TERRACES AWAY FROM THE CREEK BED ARE THE SITE OF MOST RESIDENCES AND AGRICULTURAL LAND. SOME TAILINGS MATERIAL HAS BEEN DEPOSITED ON THESE TERRACES BY FLOODWATERS AND WIND ACTION. THERE ARE ALSO ORAL REPORTS THAT TAILINGS HAVE BEEN IMPORTED TO SOME RESIDENTIAL AREAS FOR USE AS ROAD PAVING MATERIAL OR GARDEN SOIL CONDITIONERS.

THE MAJOR AQUIFERS IN THE AREA OF WHITEWOOD CREEK ARE THE SHALLOW ALLUVIAL AQUIFER, AND TWO DEEP BEDROCK AQUIFERS, THE MESOZOIC DAKOTA SANDSTONE AND THE PALEOZOIC MINNELUSA LIMESTONE. FIGURE A-2 FIGURE A-3 THE SHALLOW GROUNDWATER AT THE SITE APPEARS IN FOUR UNITS WHICH ACT AS A SINGLE AQUIFER. IT IS USEFUL TO DESCRIBE THE FOUR UNITS SEPARATELY IN ORDER TO UNDERSTAND THE MOVEMENT OF CONTAMINANTS WITHIN THE VARIOUS MEDIA.

TAILINGS DEPOSITS ARE GENERALLY COARSE-GRAINED MATERIAL, WITH SOME FINE LAYERS (UNIT 1 IN FIGURE A-3).

ALLUVIAL AQUIFER MATERIALS UNDERNEATH THE TAILINGS, WHICH ARE MOST DIRECTLY INFLUENCED BY WATER MOVING THROUGH THE TAILINGS, ARE REFERRED TO AS THE DOWNGRADIENT AQUIFER (UNIT 2 IN FIGURE A-3).

ALLUVIAL AQUIFER MATERIALS AND SHALLOW BEDROCK SHALE WITHIN THE FLOODPLAIN OUTSIDE THE IMMEDIATE INFLUENCE OF THE TAILINGS ARE REFERRED TO AS THE UPGRADIENT AQUIFER (UNIT 3 IN FIGURE A-3).

UPLAND ALLUVIAL AQUIFER TERRACE DEPOSITS ARE UPLAND AWAY FROM THE TAILINGS AND FLOODPLAIN ALLUVIAL MATERIALS (UNIT 4 IN FIGURE A-3).

THE WATER TABLE ALONG WHITEWOOD CREEK OCCURS MAINLY IN THE NATURAL ALLUVIUM UNDERLYING AND ADJACENT TO THE TAILINGS. DURING WET PERIODS OF THE YEAR, THE WATER TABLE MAY RISE INTO THE TAILINGS. SOME RECHARGE OF THE SHALLOW AQUIFER MAY OCCUR THEN, AS PRECIPITATION INFILTRATES THROUGH THE TERRACE MATERIALS AND TAILINGS DEPOSITS.

IN GENERAL, THE WATER TABLE SLOPES TOWARD THE FLOODPLAIN, AND DURING MOST OF THE YEAR, THERE IS A NET FLOW OF GROUNDWATER FROM THE ALLUVIUM INTO THE CREEK. DURING HIGH CREEK FLOW, LASTING FROM TWO TO EIGHT WEEKS EACH SPRING, THE FLOW IS REVERSED AND WATER FLOWS FROM THE CREEK AS FAR AS 200 METERS INTO THE ALLUVIUM.

MIGRATION OF CONTAMINANTS FROM THE TAILINGS TO THE ALLUVIUM AND GROUNDWATER OCCURS AT A SLOW RATE BECAUSE OF THE CHEMISTRY OF THE CONTAMINANTS AND TAILINGS DEPOSITS (SEE PAGE 14). THE UPGRADIENT ALLUVIAL AQUIFER AND UPLAND ALLUVIAL AQUIFER APPEAR TO BE UNCONTAMINATED BY TAILINGS MATERIALS. GROUNDWATER IN THE TAILINGS DEPOSITS AND THE DOWNGRADIENT ALLUVIAL AQUIFER ARE OF GREATEST CONCERN TO HUMAN HEALTH.

THE BEDROCK AQUIFERS ARE SEPARATED FROM THE SHALLOW AQUIFER BY UP TO 1,000 FEET OF RELATIVELY LOW PERMEABILITY SHALE. THE THICKNESS OF THE SHALE AND THE LACK OF CONTINUOUS POROUS ZONES IN THE SHALE BOTH SERVE TO LIMIT THE CONNECTION BETWEEN THE ALLUVIAL AND BEDROCK AQUIFERS. WATER SUPPLY WELLS IN THE BEDROCK AQUIFERS TESTED IN THE RI DID NOT CONTAIN CONTAMINANTS FROM TAILINGS DEPOSITS MATERIALS.

SOURCES AND TYPES OF CONTAMINANTS

THE INITIAL RI STUDIES COMPLETED BY FOX IN 1984 IDENTIFIED THE TAILINGS DEPOSITS AS THE SOURCE OF CONTAMINATION IN THE STUDY AREA. FOURTEEN TARGET SUBSTANCES WERE INVESTIGATED AS INDICATORS OF POTENTIAL PUBLIC HEALTH AND ENVIRONMENTAL THREAT (TABLE A-1). ARSENIC WAS CONSIDERED TO BE THE CONTAMINANT OF MOST SIGNIFICANT ENVIRONMENTAL CONCERN THROUGHOUT THE MEDIA UNDER EVALUATION. CADMIUM, COPPER AND MANGANESE WERE DETECTED AT CONCENTRATIONS ABOVE BACKGROUND LEVELS BUT TOO LOW TO BE OF CONCERN TO HUMAN HEALTH. THE REMAINING SUBSTANCES WERE EITHER DETERMINED TO BE NATURALLY OCCURRING (SULFATE, SELENIUM) OR PRESENT AT CONCENTRATIONS NEAR BACKGROUND LEVELS (CHROMIUM, SILVER, NICKEL, IRON, MERCURY, LEAD, ZINC AND CYANIDE).TABLE A-1 AFFECTED MEDIA.

THE RI/FS DOCUMENTED THAT HAZARDOUS SUBSTANCES ARE PRESENT IN A VARIETY OF MEDIA AT THE SITE INCLUDING:

- TAILINGS DEPOSITS;
- ALLUVIAL MATERIALS UNDERLYING TAILINGS DEPOSITS;
- SURFACE SOILS IN SOME OF THE IRRIGATED LANDS ADJOINING TAILINGS DEPOSITS;
- SURFACE SOILS IN RESIDENTIAL YARDS, GARDENS, AND DRIVEWAYS;
- ALLUVIAL GROUNDWATER UNDER THE TAILINGS DEPOSITS
- SURFACE WATER; AND VEGETATION.

POTENTIAL HEALTH IMPACTS AND RISK ASSESSMENTS ARE PRESENTED IN CHAPTER V. THE MEDIA POSING THE GREATEST POTENTIAL RISK TO HUMAN HEALTH AND THE ENVIRONMENT ARE LISTED BELOW. THE POTENTIAL FOR CONTAMINANTS MIGRATING BETWEEN THE MEDIA AS DEMONSTRATED BY REMEDIAL INVESTIGATIONS, ESPECIALLY THE CHERRY STUDY, IS ALSO SUMMARIZED BELOW.

SURFACE SOILS IN THE TAILINGS DEPOSIT AND FRINGE AREAS

TAILINGS DEPOSITS (MEDIUM 2, FIGURE A-2). IT IS ESTIMATED THAT 21.6 MILLION TONS OF TAILINGS EXIST WITHIN THE SITE. THE TAILINGS DEPOSITS CONTAIN CONCENTRATIONS OF ARSENIC (MAXIMUM 42,500

MILLIGRAMS PER KILOGRAM OR MG/KG) AND CADMIUM (MAXIMUM 180 MG/KG) WHICH ARE SIGNIFICANTLY ABOVE LEVELS IN UNCONTAMINATED ALLUVIAL SOILS AT THE REFERENCE SITE ON THE BELLE FOURCHE RIVER ABOVE THE CONFLUENCE WITH WHITEWOOD CREEK (12 MG/KG AND 1.5 MG/KG, RESPECTIVELY).

THE TAILINGS HAVE BEEN DETERMINED TO BE THE MAJOR SOURCE OF THE CONTAMINATION FOUND IN OTHER AFFECTED MEDIA. THE ORE BODY FROM WHICH THE TAILINGS ARE DERIVED IS A METAMORPHIC IRON MAGNESIUM CARBONATE. THE GOLD IS FOUND IN VEINS ALONG WITH QUARTZ, CALCITE, IRON AND ARSENIC SULFIDES AND OTHER MINOR METALS.

OXIDATION OF THE IRON AND ARSENIC SULFIDES IN THE TAILINGS PRODUCES A WEAK SULFURIC ACID. IN MOST CASES, THIS ACID IS BUFFERED BY CALCIUM IN THE CARBONATES IN THE ORE AND FROM THE EXPOSED SEDIMENTARY ROCKS. IN THIS BUFFERED ENVIRONMENT, THE CONTAMINANTS ARE RELATIVELY IMMOBILE. ISOLATED POCKETS HAVING AN ACID ENVIRONMENT OCCUR WITHIN THE TAILINGS AND ALLUVIUM, WHERE SOME ARSENIC MAY BE MOBILIZED.

MOST OF THE SUBSTANCES ARE TRANSPORTED IN THEIR SOLID FORM, RATHER THAN IN SOLUTION. AT PRESENT, THE CONTAMINANTS CONTAINED IN THE TAILINGS DEPOSITS ARE BEING RELEASED VERY SLOWLY INTO THE ALLUVIAL AQUIFERS. SMALL AMOUNTS ARE BEING TRANSPORTED INTO THE UNDERLYING ALLUVIUM. IT IS ANTICIPATED THAT THESE CONTAMINANTS WILL CONTINUE TO BE RELEASED THROUGH BOTH CHEMICAL AND PHYSICAL PROCESSES AT THESE SLOW RATES FOR MANY YEARS.

IN ALL BUT A FEW LOCATIONS (ESTIMATED AT 25 PERCENT OF THE AREA FOR PURPOSES OF ESTIMATING COSTS OF POTENTIAL REMEDIAL ACTION), THE TAILINGS DEPOSITS SUPPORT VEGETATION INCLUDING GRASSES, SHRUBS AND TREES. MOST UNVEGETATED AREAS HAVE A THIN GYPSUM CRUST AT THE SURFACE. THIS COVER PROVIDES SOME STABILITY FOR THESE DEPOSITS. THE TAILINGS EXHIBIT SOME INSTABILITY AT THE CREEK BANK EDGES AND WHERE COVER IS ABSENT. SOME OF THE TAILINGS WITH THEIR CONTAMINANTS ARE RELEASED TO THE SURFACE WATERS OF WHITEWOOD CREEK. IT IS ESTIMATED THAT 7,000 KG OF ARSENIC MAY BE ADDED TO THE SURFACE WATERS FROM NORMAL EROSION, HEAVY RAINFALL AND SEEPAGE DURING A NORMAL YEAR. PERIODIC FLOODING EVENTS MAY INTRODUCE AN ADDITIONAL 35,000 KG IN A SINGLE EVENT.

THE POTENTIAL RISK TO HUMAN HEALTH THROUGH INADVERTENT INGESTION OF TAILINGS WAS EVALUATED AS PART OF THE SOIL EXPOSURE PATHWAY.

ALLUVIAL MATERIALS UNDERLYING TAILINGS DEPOSITS (MEDIUM 1, FIGURE A-2). IT IS ESTIMATED THAT AT LEAST 10 MILLION TONS OF ALLUVIUM UNDERLIE THE TAILINGS DEPOSITS WITHIN THE SITE. THE ALLUVIUM UNDERLYING THE TAILINGS DEPOSITS CONSISTENTLY EXHIBITS ELEVATED LEVELS OF ARSENIC (MAXIMUM 700 MG/KG).

WHILE THE CONTAMINANTS WITHIN THE ALLUVIUM ARE RELATIVELY IMMOBILE, THEY ARE BEING RELEASED VERY SLOWLY TO ALLUVIAL AQUIFERS, AND TRANSPORTED IN SMALL AMOUNTS TO THE SURFACE WATERS OF WHITEWOOD CREEK. THERE MAY BE SOME SCOURING OF ALLUVIAL MATERIALS FROM THE BANK INTO THE CREEK DURING HIGH RIVER FLOWS. IN MOST INSTANCES, THE ALLUVIUM IS COVERED BY TAILINGS AND THE CONTAMINANTS WITHIN IT ARE INSULATED FROM, AND NOT AVAILABLE TO, SURFACE TRANSPORT PROCESSES, SUCH AS EROSION OR RUNOFF. BECAUSE OF THE COVERING TAILINGS DEPOSITS, NO HUMAN HEALTH EXPOSURE PATHWAYS EXIST.

IRRIGATED SOILS (MEDIA 3, 4, AND 5, FIGURE A-2). APPROXIMATELY 83 ACRES OF IRRIGATED CROPLAND ARE LOCATED WITHIN THE SITE. ABOUT ONE-FOURTH OF THE WATER USED FOR IRRIGATION COMES FROM UPGRADIENT ALLUVIAL OR BEDROCK AQUIFERS, ONE-FOURTH FROM WHITEWOOD CREEK AND ONE-HALF FROM THE BELLE FOURCHE RIVER. ONLY SOME PORTIONS OF THE TOTAL IRRIGATED CROPLANDS ARE CONTAMINATED BY ARSENIC. OVERBANK FLOODING AND WINDBLOWN TAILINGS MATERIALS PROBABLY CONTRIBUTED MOST OF THE CONTAMINATION, ALTHOUGH WHITEWOOD CREEK SURFACE WATER MAY HAVE CONTRIBUTED SMALL AMOUNTS OF ARSENIC TO THE SOIL WHERE IT IS USED FOR IRRIGATION.

ARSENIC LEVELS ARE ELEVATED IN SAMPLES OF IRRIGATED SOILS TAKEN AT DIFFERENT LOCATIONS THROUGHOUT THE SITE (MAXIMUM 600 MG/KG). THERE IS NO INDICATION THAT CONTAMINANTS IN THE IRRIGATED SOILS ARE MIGRATING INTO THE ALLUVIAL GROUNDWATERS BECAUSE OF THE RELATIVE IMMOBILITY AND LOW CONCENTRATIONS OF ARSENIC IN THESE SOILS. CONTAMINANT UPTAKE BY CROPS OCCURS TO VARYING DEGREES, DEPENDING ON THE CONTAMINANT. THE POTENTIAL RISK TO HUMAN HEALTH THROUGH INADVERTENT INGESTION OF CONTAMINATED SOIL WAS EVALUATED AS PART OF THE SOIL EXPOSURE PATHWAY. THE POTENTIAL RISK DUE TO INGESTION OF CROPS IS DISCUSSED BELOW IN THE SECTION ON VEGETATION.

SURFACE SOILS IN RESIDENTIAL YARDS, GARDENS AND DRIVEWAYS (MEDIUM 6, FIGURE A-2). THE CONTAMINATION IN THE RESIDENTIAL AREAS IS FROM WINDBLOWN TAILINGS MATERIALS AND FROM TAILINGS

MATERIALS INADVERTENTLY TRANSPORTED IN BY DIRTY WORK BOOTS ETC. OR IMPORTED FOR USE AS A SOIL CONDITIONER AND DRIVEWAY BASE. THREE RESIDENTIAL PROPERTIES WITHIN THE SITE HAVE BEEN FOUND TO HAVE SURFACE SOIL ARSENIC CONTAMINATION (MAXIMUMS: LAWN 520 MG/KG, GARDEN 540 MG/KG, DRIVEWAY 2400 MG/KG). IN THESE SAMPLES, MAXIMUM CONCENTRATIONS WERE REPORTED IN THE 0-6 INCH SAMPLES. CONCENTRATIONS OF ARSENIC IN THE 18 AND 24 INCH DEPTH SAMPLES WERE ABOVE BACKGROUND FOR THE AREA BUT LESS THAN 100 MG/KG. OTHER RESIDENTIAL PROPERTIES WITHIN THE SITE HAVE NOT BEEN SAMPLED. APPROXIMATELY 12 RESIDENCES WERE ESTIMATED IN THE FEASIBILITY STUDY TO HAVE ARSENIC CONCENTRATIONS GREATER THAN 100 MG/KG. THE TOTAL NUMBER OF AFFECTED RESIDENCES AND AMOUNT OF CONTAMINATED MATERIAL WILL BE DETERMINED DURING THE REMEDIAL DESIGN PHASE OF THE SUPERFUND WORK.

THERE IS NO INDICATION THAT CONTAMINANTS CONTAINED IN THESE SOILS ARE MIGRATING INTO THE ALLUVIAL GROUNDWATERS BECAUSE OF THE RELATIVE IMMOBILITY AND LOW CONCENTRATION OF ARSENIC IN THESE SOILS.

THE POTENTIAL RISK TO HUMAN HEALTH THROUGH INADVERTENT INGESTION OF CONTAMINATED SOIL WAS EVALUATED AS PART OF THE SOIL EXPOSURE PATHWAY.

DOWNGRADIENT ALLUVIAL GROUNDWATER. THE WATER FROM THE DOWNGRADIENT ALLUVIAL AQUIFER (UNIT 2, FIGURE A-3) IS THE ONLY GROUNDWATER TO EXHIBIT ELEVATED LEVELS OF CONTAMINANTS. CONCENTRATIONS OF ARSENIC (MAXIMUM: 0.78 MG/L) ARE DETECTED ABOVE BACKGROUND LEVELS. THESE CONCENTRATIONS EXCEED PRIMARY DRINKING WATER STANDARDS AND THE SOUTH DAKOTA DRINKING WATER STANDARDS.

THE WATER TABLE ALONG WHITEWOOD CREEK OCCURS MAINLY IN THE NATURAL ALLUVIUM UNDERLYING THE TAILINGS. DURING WET PERIODS OF THE YEAR, THE WATER TABLE MAY RISE INTO THE TAILINGS. SOME RECHARGE OF THE SHALLOW ALLUVIAL AQUIFER MAY OCCUR THEN, THROUGH INFILTRATION OF PRECIPITATION MOVING THROUGH THE TERRACE DEPOSITS AND THE TAILINGS DEPOSITS. IN GENERAL, THE WATER TABLE SLOPES TOWARD THE FLOODPLAIN AND, DURING MOST OF THE YEAR, THERE IS A NET FLOW OF GROUNDWATER FROM THE ALLUVIUM INTO THE CREEK. DURING HIGH CREEK FLOW, LASTING FROM TWO TO EIGHT WEEKS EACH YEAR, THIS FLOW IS REVERSED. THE EFFECT OF RECHARGE FROM THE STREAM MAY BE SEEN AS MUCH AS 200 METERS FROM THE STREAM. IN THE AREAS WHERE THE TAILINGS DEPOSITS ARE FINE-GRAINED WITH LOW PERMEABILITY, LOCALIZED PERCHED ZONES PRODUCE SMALL SEEPS AND SPRINGS ALONG THE BANK OF THE CREEK. GYPSUM CRUSTS FORM IN PLACES AT THE SURFACE OF THE TAILINGS AND AT THE SEEPS.

THREE MECHANISMS APPEAR TO ACT IN MOVEMENT OF ARSENIC FROM THE TAILINGS TO THE GROUNDWATER: 1) DISSOLUTION OF ARSENIC DURING THOSE TIMES OF THE YEAR WHEN THE WATER TABLE IS IN THE TAILINGS, 2) DISSOLUTION OF ARSENIC WHEN PRECIPITATION INFILTRATES DOWNWARD THROUGH THE TAILINGS AND 3) INCORPORATION OF TAILINGS PARTICLES INTO THE ALLUVIUM, WHICH PROBABLY OCCURRED AS THE TAILINGS WERE BEING DEPOSITED. MOVEMENT OF CONTAMINANTS PRESENTLY CONTINUES AT A SLOW RATE, AND COULD CONTINUE FOR THOUSANDS OF YEARS.

THE POTENTIAL RISK TO HUMAN HEALTH OCCURS THROUGH INGESTION OF CONTAMINATED GROUNDWATER.

SURFACE WATERS OF WHITEWOOD CREEK. THE CONCENTRATIONS OF CONTAMINANTS (TABLE A-1) IN SURFACE WATERS OF WHITEWOOD CREEK COMPLY WITH WATER QUALITY STANDARDS ESTABLISHED BY SOUTH DAKOTA FOR WHITEWOOD CREEK AND EPA WATER QUALITY CRITERIA FOR CHRONIC TOXICITY TO AQUATIC LIFE. CONCENTRATIONS OF ARSENIC AT THE US GEOLOGICAL SURVEY VALE SAMPLING STATION, DOWNSTREAM OF THE SITE, OCCASIONALLY EXCEED THE WATER QUALITY CRITERIA FOR THE PROTECTION OF HUMAN HEALTH FROM THE CONSUMPTION OF FISH. THESE EXCEEDANCES ARE DUE IN PART TO UPSTREAM SOURCES AND TO THE ADDITIONAL CONTRIBUTIONS FROM THE TAILINGS DEPOSITS ALONG THE CREEK WITHIN THE SITE.

THE UPSTREAM SOURCES INCLUDE MINOR UNQUANTIFIED DISCHARGES OF MUNICIPAL AND INDUSTRIAL WASTEWATERS FROM THE COMMUNITIES OF LEAD, DEADWOOD AND WHITEWOOD. MINOR ADDITIONAL CONTAMINATION MAY BE ATTRIBUTED TO THE FEW TAILINGS DEPOSITS BETWEEN THE HOMESTAKE MINE AND THE BEGINNING OF THE WHITEWOOD CREEK SUPERFUND SITE AT THE CROOK CITY BRIDGE.

HOMESTAKE MINE DISCHARGE ALSO CONTRIBUTES TO THE UPSTREAM LOADING. PRIOR TO THE INSTALLATION OF THE GRIZZLY GULCH TAILINGS IMPOUNDMENT AND HOMESTAKE'S WASTEWATER TREATMENT PLANT, THE SURFACE WATER IN WHITEWOOD CREEK BELOW THE MINE WAS SUBSTANTIALLY DEGRADED AND INCAPABLE OF SUPPORTING AQUATIC LIFE. FOLLOWING COMPLETION OF THE TREATMENT PLANT, HOMESTAKE HAS BEEN DISCHARGING TO WHITEWOOD CREEK UNDER A DRAFT PERMIT FROM THE STATE OF SOUTH DAKOTA. THE ALLOWABLE DISCHARGE CONCENTRATIONS FOR ARSENIC (0.184 MG/L, DAILY MAXIMUM; 0.105 MG/L, DAILY AVERAGE) IN THE TREATMENT PLANT EFFLUENT WERE DEVELOPED TO BE PROTECTIVE OF A COLD WATER FISHERY USAGE OF WHITEWOOD CREEK BETWEEN LEAD AND THE SUPERFUND SITE USING AMBIENT WATER QUALITY ABOVE THE

DISCHARGE, AND WASTELOAD ALLOCATION CALCULATIONS. THE PRESENT ARSENIC CONCENTRATIONS IN THE EFFLUENT AT THE DISCHARGE POINT LOCATED NEAR THE TOWN OF LEAD AVERAGE 0.03 MG/L WITH MAXIMUMS OF 0.06 MG/L.

THE WATER QUALITY OF WHITEWOOD CREEK IS DIFFERENT AS IT LEAVES THE SITE FROM THAT ENTERING THE SITE. GROUNDWATER SEEPING THROUGH THE TAILINGS AND ALLUVIUM INTO THE CREEK ADDS AN AVERAGE OF 365 KG/YEAR OF ARSENIC TO THE CREEK. NORMAL EROSION OF TAILINGS ALONG WHITEWOOD CREEK CONTRIBUTES ON THE AVERAGE OF 300 KG/YEAR OF ARSENIC AND HEAVY RAINS MAY CONTRIBUTE ANOTHER 6,000 KG/YEAR. DURING PERIODIC FLOOD EVENTS UP TO 35,000 KG OF ARSENIC IS ADDED TO WHITEWOOD CREEK FROM THE EROSION OF THE TAILINGS. THIS ADDED LOAD OF CONTAMINANTS TO THE SURFACE WATER ACROSS THE SITE RESULTS IN AN INCREASE OF ARSENIC CONCENTRATIONS WHICH VARIES WITH THE AMOUNT OF FLOW IN THE CREEK AND TIME OF YEAR.

THE LEVELS OF DISSOLVED ARSENIC AT THE DOWNSTREAM END OF THE SITE EXCEED WATER QUALITY CRITERIA FOR THE PROTECTION OF HUMAN HEALTH FROM THE CONSUMPTION OF FISH. THE LEVELS ALSO PERIODICALLY EXCEED THE NATIONAL PRIMARY DRINKING WATER STANDARDS FOR ARSENIC OF 0.05 MG/L AND HAVE APPROACHED THE CRITERIA ESTABLISHED BY THE EPA FOR CHRONIC TOXICITY TO AQUATIC LIFE OF 0.190 MG/L. THE OBSERVED CHANGES IN WATER QUALITY ARE RELATED TO THE UNCONTROLLED RELEASES FROM THE SITE THROUGHOUT THE YEAR AS WELL AS THE PROCESSES WHICH LEAD TO REMOVAL OF CONTAMINANTS FROM THE WATER COLUMN TO THE SEDIMENT OF THE STREAM BED. CONSEQUENTLY, THE RANGE OF OBSERVED PERCENT CHANGE IN ARSENIC CONCENTRATIONS IN WHITEWOOD CREEK REPORTED BETWEEN 1985 AND 1987 WAS FROM A LOSS OF 80 PERCENT IN SEPTEMBER 1985 TO AN INCREASE OF 490 PERCENT IN JULY 1985.

PRELIMINARY CALCULATIONS IN THE RI/FS INDICATED THAT THE POTENTIAL RISK TO HUMAN HEALTH OF INGESTING CONTAMINATED WATER IS TOO LOW TO BE OF CONCERN, IN PART BECAUSE THERE IS NO CURRENT OR ANTICIPATED FUTURE USE OF WHITEWOOD CREEK SURFACE WATER FOR DRINKING. THE NATIONAL PRIMARY DRINKING WATER STANDARDS FOR ARSENIC ARE THEREFORE NEITHER APPLICABLE, RELEVANT OR APPROPRIATE AS A REQUIREMENT FOR WHITEWOOD CREEK. THERE ARE NO APPLICABLE STANDARDS FOR TOXICANTS IN THE REACH OF WHITEWOOD CREEK WITHIN THE SITE. HOWEVER, THE EPA, 1986 QUALITY CRITERIA FOR WATER DOCUMENT ESTABLISHED ARSENIC LEVELS FOR PREVENTING CHRONIC TOXICITY OF 0.190 MG/L WHICH MAY BE CONSIDERED AS A RELEVANT AND APPROPRIATE LEVEL FOR PROTECTION OF THE SEMIPERMANENT WARMWATER FISHERY DESIGNATED BY THE STATE FOR WHITEWOOD CREEK WITHIN THE SITE. DUE TO THE POTENTIAL FOR EXCEEDANCES OF THE NATIONAL CHRONIC TOXICITY CRITERIA, COUPLED WITH THE UNCERTAIN FUTURE RATES OF RELEASE OF ARSENIC FROM THE TAILINGS DEPOSITS, EPA HAS DETERMINED THAT CONTINUED MONITORING OF WHITEWOOD CREEK WATER QUALITY IS NEEDED.

VEGETATION. CERTAIN NATIVE PLANTS GROWING ON THE TAILINGS DEPOSIT AREAS CONTAIN CONCENTRATIONS OF ARSENIC (MAXIMUM 240 MG/KG, TABLE A-1) ABOVE THAT OF VEGETATION FROM THE REFERENCE AREA. SOME CULTIVATED CROPS (ALFALFA, FOR EXAMPLE) CONTAINED CONCENTRATIONS OF ARSENIC ELEVATED ABOVE BACKGROUND, BUT BELOW LEVELS CITED AS PRODUCING REDUCTION IN CROP PRODUCTIVITY OR CAUSING TOXIC EFFECTS IN LIVESTOCK. ARSENIC LEVELS WERE NOT ELEVATED IN CROPS FOR DIRECT HUMAN CONSUMPTION. DURING THE ENDANGERMENT ASSESSMENT, CONSUMPTION OF VEGETATION WAS NOT CONSIDERED AS A TRANSPORT PATHWAY, BECAUSE OF THE LOW ARSENIC LEVELS AND BECAUSE ARSENIC DOES NOT ACCUMULATE IN TISSUE OR INCREASE IN CONCENTRATION AS IT PROGRESSES UP THE FOOD CHAIN.

#SSR

V. SUMMARY OF SITE RISKS

ACTUAL OR THREATENED RELEASES OF HAZARDOUS SUBSTANCES FROM THIS SITE, IF NOT ADDRESSED BY IMPLEMENTING THE RESPONSE ACTION SELECTED IN THIS ROD, MAY PRESENT AN IMMINENT AND SUBSTANTIAL ENDANGERMENT TO PUBLIC HEALTH, WELFARE, OR THE ENVIRONMENT.

CERCLA MANDATES THAT EPA SELECT REMEDIES THAT PROTECT HUMAN HEALTH AND THE ENVIRONMENT FROM CURRENT AND POTENTIAL EXPOSURES TO HAZARDOUS SUBSTANCES. THEREFORE, EPA HAS CONDUCTED ENDANGERMENT ASSESSMENTS (EA) TO EVALUATE THE RISKS POSED BY THE PRESENCE OF CONTAMINANTS AT THE WHITEWOOD CREEK SITE. THESE STUDIES ARE LISTED IN SECTION II OF THIS DOCUMENT. THE RISK ANALYSES RESULTING FROM EPA'S SUMMARY DOCUMENT WERE USED FOR THE FEASIBILITY STUDY AND FOR THIS RECORD OF DECISION.

FOR A RISK TO EXIST, THREE COMPONENTS MUST BE PRESENT: 1) A SOURCE OF CONTAMINATION; 2) A PATHWAY FOR CONTAMINANTS TO REACH HUMANS, PLANTS OR ANIMALS; AND 3) A POPULATION THAT COULD POTENTIALLY BE EXPOSED. IF ANY OF THE THREE COMPONENTS IS MISSING, NO RISK CAN EXIST.

THE KEY COMPONENT OF ANY HEALTH RISK ASSESSMENT IS THE AMOUNT OF CHEMICAL REACHING THE POPULATION. THIS IS KNOWN AS THE DOSE. FOR ANY GIVEN DOSE, THERE ARE TWO GENERAL TYPES OF TOXIC RESPONSES: NON-CARCINOGENIC AND CARCINOGENIC (CANCER-CAUSING).

NON-CARCINOGENIC RISKS ARE CALCULATED BY ASSUMING THAT THERE IS A DOSE BELOW WHICH NO ADVERSE HEALTH EFFECTS WILL OCCUR. THESE CALCULATIONS ARE USUALLY BASED ON RESULTS OF ANIMAL STUDIES AND INCLUDE A NUMBER OF ADDITIONAL CONSERVATIVE ASSUMPTIONS TO TAKE INTO ACCOUNT THAT THE ESTIMATED RISK IS TO HUMANS. FOR SUCH CHEMICALS, EXPOSURES LESS THAN THIS DOSE (REFERRED TO AS THE "REFERENCE DOSE") WILL RESULT IN NO TOXIC EFFECTS. MANY OF THE 14 METAL CONTAMINANTS FOUND AT WHITEWOOD CREEK SUPERFUND SITE HAVE AN EFFECT ON MULTIPLE ORGAN SYSTEMS. THEREFORE, THE METHOD OF ADDING ALL THE CONTAMINANT-SPECIFIC RISK ESTIMATES WAS CONSIDERED APPROPRIATE FOR ESTIMATING ACTUAL RISKS. POTENTIAL CONCERN FOR NON-CARCINOGENIC EFFECTS OF A SINGLE CONTAMINANT IN A SINGLE MEDIUM IS EXPRESSED AS THE HAZARD QUOTIENT (HQ) (OR THE RATIO OF THE ESTIMATED INTAKE DERIVED FROM THE CONTAMINANT CONCENTRATION IN A GIVEN MEDIUM TO THE CONTAMINANT'S REFERENCE DOSE). BY ADDING THE HQS FOR ALL CONTAMINANTS WITHIN A MEDIUM OR ACROSS ALL MEDIA TO WHICH A GIVEN POPULATION MAY REASONABLY BE EXPOSED, THE HAZARD INDEX (HI) CAN BE GENERATED. THE HI PROVIDES A USEFUL REFERENCE POINT FOR GAUGING THE POTENTIAL SIGNIFICANCE OF MULTIPLE CONTAMINANT EXPOSURES WITHIN A SINGLE MEDIUM OR ACROSS MEDIA.

FOR CARCINOGENS, IT APPEARS THAT THERE IS NO SAFE DOSE. INSTEAD, THE RISK OF CANCER BECOMES SMALLER AND SMALLER AS THE DOSE DECREASES. CANCER POTENCY FACTORS (CPFS) ARE USED FOR ESTIMATING EXCESS LIFETIME CANCER RISKS ASSOCIATED WITH EXPOSURE TO POTENTIALLY CARCINOGENIC CHEMICALS. EXCESS LIFETIME CANCER RISKS ARE DETERMINED BY MULTIPLYING THE INTAKE LEVEL WITH THE CANCER POTENCY FACTOR. THESE RISKS ARE PROBABILITIES THAT ARE GENERALLY EXPRESSED IN SCIENTIFIC NOTATION (E.G., 1 X (10-6) OR 1 E-6). AN EXCESS LIFETIME CANCER RISK OF 1 X (10-6) INDICATES THAT AN INDIVIDUAL HAS A ONE IN ONE MILLION CHANCE OF DEVELOPING CANCER AS A RESULT OF SITE-RELATED EXPOSURE TO A CARCINOGEN OVER A 70-YEAR LIFETIME UNDER THE SPECIFIC EXPOSURE CONDITIONS AT A SITE. A RISK IN THE RANGE OF (10-4) TO (10-6) IS CONSIDERED TO BE ACCEPTABLE. EPA GENERALLY USES (10-6) AS A GOAL IN EVALUATING CLEANUP ALTERNATIVES. HOWEVER, OTHER FACTORS, SUCH AS EXPOSURE, TECHNICAL LIMITATIONS, BACKGROUND CONCENTRATIONS, AND UNCERTAINTIES MAY RESULT IN THE SETTING OF A DIFFERENT GOAL.

CONTAMINANTS

THE MEDIA MOST CONTAMINATED BY ARSENIC AND CADMIUM, THE CONTAMINANTS OF GREATEST CONCERN FOR THIS SITE, ARE THE DOWNGRADIENT ALLUVIAL AQUIFER, TAILINGS DEPOSITS, IRRIGATED CROPLAND SOILS AND RESIDENTIAL SOILS. EACH OF THESE MEDIA CONTRIBUTE A PORTION OF THE DOSE INGESTED BY THE EXPOSED POPULATION DEPENDING UPON THE CONCENTRATIONS OF CONTAMINANTS IN THE MEDIA AND THE INDIVIDUALS EXPOSURE TO THE MEDIA. SECTION V DISCUSSES THE VOLUME AND MOBILITY OF CONTAMINANTS IN THESE MEDIA IN GREATER DETAIL. SEE TABLE A-2 FOR AVERAGE CONCENTRATIONS OF ALL SUBSTANCES ASSESSED IN THE EA. THE DISCUSSION WHICH FOLLOWS OUTLINES ASSUMED EXPOSURE PATTERNS FOR A VARIETY OF EXPOSURE SCENARIOS.

PATHWAYS

THERE ARE A NUMBER OF PATHWAYS BY WHICH CONTAMINANTS FROM THE TAILINGS DEPOSITS MAY REACH INDIVIDUALS LIVING WITHIN OR VISITING THE SITE. EPA'S EA FOR THE SITE CONCLUDED THAT THE PATHWAYS WHICH PRESENT THE HIGHEST RISK ARE INGESTION OF GROUNDWATER AND INGESTION OF CONTAMINATED SOIL MEDIA (TAILINGS DEPOSITS, IRRIGATED CROPLAND SOILS AND RESIDENTIAL SOILS).

THE EXISTING RANCHES AND POTENTIAL RANCH SITES IN THE WHITEWOOD CREEK AREA COULD BE EXPECTED TO UTILIZE GROUNDWATER FROM THE UPGRADIENT ALLUVIAL AQUIFER. RANCHES COULD ALSO HYPOTHETICALLY USE THE DOWNGRADIENT ALLUVIAL AQUIFER IN THE FUTURE (SEE FIGURE A-2 AND A-3).

SOME OF THE RANCHES EXIST NEAR TAILINGS DEPOSITS AND/OR CONTAMINATED IRRIGATED SOILS. INADVERTENT SOIL INGESTION COULD OCCUR AT THESE RANCHES DURING AN INDIVIDUAL'S LIFETIME FROM SUCH ACTIVITIES AS PLAYING, HUNTING, FISHING, CUTTING WOOD, GARDENING, AND WORKING IN THE YARDS AND FIELDS. FURTHERMORE, HOUSEHOLD DUST MIGHT CONTAIN ARSENIC BLOWN IN OR MECHANICALLY TRANSPORTED (E.G., DIRTY WORK BOOTS) FROM TAILINGS AND CROPLAND SOILS. MOST LARGE DUST PARTICLES WHICH ARE BREATHED INTO THE LUNGS ARE REMOVED FROM THE LUNGS BY THE LUNG'S SELF CLEANING ACTION. CONTAMINANTS CAN BECOME INCORPORATED INTO MUCUS AND SWALLOWED, IN A PATHWAY REFERRED TO AS INCIDENTAL SOIL INGESTION.

ADDITIONAL PATHWAYS WERE ALSO CONSIDERED, BUT RISK CALCULATIONS WERE NOT DEVELOPED. RISKS FOR THE CONSUMPTION OF HOMEGROWN FOODSTUFFS, THE AIR PATHWAY (THROUGH INHALATION OF RESPIRABLE PARTICLES) AND THE SURFACE WATER PATHWAY WERE NOT CALCULATED IN THE ENDANGERMENT ASSESSMENT BECAUSE PRELIMINARY CALCULATIONS IN THE RI/FS INDICATED CONCENTRATIONS OF CONTAMINANTS AND THE POTENTIAL FOR EXPOSURE THROUGH THESE PATHWAYS WERE TOO LOW TO BE OF CONCERN.

POPULATION EXPOSURE SCENARIOS

THE EXPOSURE TO THE POTENTIAL CARCINOGEN, ARSENIC (TABLE A-2), AND NON-CARCINOGENIC METALS IN SOIL AND GROUNDWATER VIA INGESTION WAS EVALUATED FOR FOUR EXPOSURE SCENARIOS. THESE INCLUDE 1) A REPRESENTATIVE ADULT SITE RESIDENT, 2) A REPRESENTATIVE CHILD SITE RESIDENT, 3) A RECREATIONAL VISITOR, AND 4) A HYPOTHETICAL FUTURE (MAXIMUM EXPOSED) SITE RESIDENT. ASSUMPTIONS FOR INGESTION RATES ARE INCLUDED IN APPENDIX A. TABLE A-2 REPRESENTATIVE RESIDENT (ADULT AND CHILD). THIS SCENARIO WAS EXAMINED TO ASSESS THE POTENTIAL RISK TO A CURRENT REPRESENTATIVE SITE RESIDENT. USING THE EXPOSURE ASSUMPTIONS OUTLINED IN THE PARAGRAPHS WHICH FOLLOW, IT WAS DETERMINED THAT THE CARCINOGENIC RISKS TO THE REPRESENTATIVE SITE RESIDENT ARE 1 X (10-4) THROUGH EXPOSURE TO GROUNDWATER, AND 2.4 X (10-4) THROUGH EXPOSURE TO ALL SOILS WITH A TOTAL RISK OF 4.3 X (10-4). THE REPRESENTATIVE ADULT SITE RESIDENT IS NOT CONSIDERED TO BE EXPOSED TO EXCESSIVE NON-CARCINOGENIC RISK BECAUSE THE HAZARD INDEX FOR GROUNDWATER WAS 0.54 AND FOR SOIL 0.14, A TOTAL HAZARD INDEX OF 0.7 (LESS THAN 1). THE REPRESENTATIVE CHILD SITE RESIDENT WAS CONSIDERED TO BE EXPOSED TO EXCESSIVE NON-CARCINOGENIC RISK FROM INGESTION OF SOIL BECAUSE THE HAZARD INDEX CALCULATED WAS 1.0 (EQUAL TO 1).

THE REPRESENTATIVE SITE RESIDENT CARCINOGENIC RISK SCENARIO CONSIDERS EXPOSURES WHICH A PERSON LIVING AND WORKING ON SITE WOULD ENCOUNTER DURING SIX YEARS AS A CHILD AND THIRTY YEARS AS AN ADULT. FOR ADULT NON-CARCINOGENIC RISK, ONLY EXPOSURE LEVELS DUE TO ADULT ACTIVITIES ARE ASSUMED. ADULTS ARE ASSUMED TO BE EXPOSED TO SOILS FROM THE CONTAMINATED RESIDENTIAL, IRRIGATED CROPLAND, AND TAILINGS AREAS, AND WATER FROM THE UPGRADIENT ALLUVIAL AQUIFER. THE UPGRADIENT AQUIFER WAS CHOSEN AS REPRESENTATIVE OF PRESENT CONDITIONS, BECAUSE DOWNGRADIENT WELLS ARE PRESENTLY BANNED BY THE STATE OF SOUTH DAKOTA AND THERE ARE NO USERS OF THIS AQUIFER.

THE FRACTION OF DAILY SOILS INGESTION FROM DIFFERING AREAS ON SITE IS ASSUMED TO BE PROPORTIONAL TO TIME SPENT AT THAT AREA. IT IS ALSO ASSUMED THAT SOIL IS TOO FROZEN TO BE INGESTED FOR 33 PERCENT OF THE YEAR. FOR THE ADULT, 16 HOURS PER DAY IS ASSUMED TO BE SPENT AT OR NEAR THE RESIDENCE. IT WAS ESTIMATED THAT RESIDENTS ARE EXPOSED 260 HOURS PER YEAR TO TAILINGS DEPOSITS SOILS WHILE ENGAGED IN ACTIVITIES SUCH AS WOODCUTTING, HUNTING, AND VARIOUS MINOR AGRICULTURAL ACTIVITIES. IT WAS ALSO ESTIMATED THAT THE RESIDENT WOULD BE WORKING AT IRRIGATED CROPLAND SOIL LOCATIONS FOR APPROXIMATELY 3.4 HOURS PER 8 HOUR WORK DAY PER 5 DAY WORK WEEK.

CHILDREN IN THIS SCENARIO ARE ASSUMED TO BE EXPOSED ONLY TO RESIDENTIAL SOIL ON SITE AND ALSO TO UPGRADIENT ALLUVIAL AQUIFER GROUNDWATER. THE AVERAGE RESIDENT CHILD (AGE GROUP 1-6 YEARS) IS ASSUMED TO BE EXPOSED TO MOBILE (NOT FROZEN) CONTAMINATED SOILS AT RESIDENTIAL AREAS 90 PERCENT (21.6 HOURS) OF THE AVERAGE DAY.

RECREATIONAL VISITOR. THE RECREATIONAL VISITOR SCENARIO WAS EXAMINED TO ASSESS THE POTENTIAL RISK ASSOCIATED WITH THE USE OF WHITEWOOD CREEK AREA FOR RECREATIONAL PURPOSES BY PERSONS WHO DO NOT LIVE WITHIN THE SITE. ASSUMING THAT THE RECREATIONAL VISITOR WOULD ONLY BE EXPOSED TO TAILINGS DEPOSIT SOILS AS DETAILED IN THE FOLLOWING PARAGRAPH, IT WAS DETERMINED THAT THIS PERSON WOULD INCUR A CARCINOGENIC RISK OF 8.2 X (10-5). THE RECREATIONAL VISITOR WOULD NOT INCUR AN UNACCEPTABLE NON-CARCINOGENIC RISK FROM SOIL INGESTION BECAUSE THE HAZARD INDEX CALCULATED WAS .05 (LESS THAN 1).

THE RECREATIONAL VISITOR SCENARIO ASSUMES THAT A PERSON HUNTING AND FISHING AT THE SITE COULD BE EXPOSED TO CONTAMINANTS THROUGH INCIDENTAL INGESTION OF TAILINGS DEPOSIT SOILS. THIS PERSON IS ESTIMATED TO BE EXPOSED TO SOILS AT THE TAILINGS AREAS APPROXIMATELY ONCE PER WEEK FOR 6 MONTHS PER YEAR FOR A PERIOD OF 20 YEARS (A TOTAL OF 520 OCCURRENCES OF EXPOSURE). FOR THIS SCENARIO, IT IS ALSO ASSUMED THAT INCIDENTAL INGESTION AND DERMAL ABSORPTION OF WHITEWOOD CREEK SURFACE WATER REPRESENTS INSIGNIFICANT HUMAN EXPOSURE PATHWAYS.

MAXIMUM EXPOSED RESIDENT. THE MAXIMUM EXPOSED RESIDENT SCENARIO WAS EXAMINED TO ASSESS THE RISK ASSOCIATED WITH A PERSON WHO MAY HAVE THE MAXIMUM EXPOSURE TO SITE CONTAMINANTS, BASED ON REASONABLE ASSUMPTIONS. USING THE EXPOSURE ASSUMPTIONS OUTLINED IN THE PARAGRAPHS WHICH FOLLOW, IT WAS DETERMINED THAT THE CARCINOGENIC RISKS TO THE MAXIMUM EXPOSED SITE RESIDENT ARE 4.4 X

(10-4) THROUGH EXPOSURE TO GROUNDWATER, AND 2.6 X (10-3) THROUGH EXPOSURE TO ALL SOILS WITH A TOTAL RISK OF 7.0 X (10-3). THE MAXIMUM EXPOSED SITE RESIDENT IS CONSIDERED TO BE EXPOSED TO EXCESSIVE NON-CARCINOGENIC RISK BECAUSE THE HAZARD INDEX FOR GROUNDWATER WAS 3.8 AND FOR SOIL 1.1, A TOTAL HAZARD INDEX OF 4.9 (GREATER THAN 1).

THE MAXIMUM EXPOSED RESIDENT SCENARIO IS A HYPOTHETICAL EXPOSURE SCENARIO WHICH ASSUMES THAT FUTURE DEVELOPMENT OCCURS ON SITE, RESULTING IN THE BUILDING OF RESIDENCES ON THE TAILINGS SOILS AND ALSO RESULTING IN THE USE OF DOWNGRADIENT ALLUVIAL AQUIFER WATER FOR DRINKING PURPOSES. THE SCENARIO CONSIDERS EXPOSURES THAT A RESIDENT WOULD INCUR BY SIMPLY LIVING ON SITE. FOR CARCINOGENIC RISK, 30 YEARS OF ADULT EXPOSURE AND AN ADDITIONAL 6 YEARS OF EXPOSURE AS A CHILD HAVE BEEN ASSUMED. FOR ADULT NON-CARCINOGENIC RISKS, ONLY ADULT EXPOSURE LEVELS ARE ASSUMED.

ADULTS ARE ASSUMED TO BE EXPOSED TO TAILINGS DEPOSIT SOILS FOR APPROXIMATELY TWO-THIRDS OF EACH DAY, AND THAT TAILINGS ARE FROZEN 33 PERCENT OF THE YEAR. IN THIS SCENARIO, IT IS ASSUMED THAT THE AVERAGE CHILD RESIDENT WILL SPEND 90 PERCENT OF THE AVERAGE DAY IN THE TAILINGS AREAS, WHICH ARE FROZEN 33 PERCENT OF THE YEAR.

RISK CHARACTERIZATION

THE RESULTS OF EPA'S EA INDICATED THAT ARSENIC IS THE CONTAMINANT OF CONCERN FOR NON-CARCINOGENIC AND CARCINOGENIC RISKS ASSOCIATED WITH SITE EXPOSURE. CONCENTRATIONS OF ARSENIC EXCEED BACKGROUND LEVELS AND RESULT IN AN UNACCEPTABLE RISK TO CURRENT AND FUTURE SITE RESIDENTS. EPA HAS DETERMINED THAT AN EXCESS UPPER BOUND CANCER RISK OF LESS THAN 1 X (10-4) IS ACCEPTABLE FOR THE SITE.

THE BACKGROUND CONCENTRATION OF ARSENIC CORRESPONDS APPROXIMATELY TO 2X (10-4) RISK THROUGH INGESTION OF GROUNDWATER AND 1 X (10-5) TO 5 X (10-5) THROUGH INGESTION OF SOILS (BASED ON SITE INFORMATION AND EPA 1983, HAZARDOUS WASTE LAND TREATMENT, SW-874 (28A). EPA REQUIRES THAT ACCEPTABLE EXPOSURE LEVELS REPRESENT AN EXCESS UPPER BOUND CANCER RISK OF (10-4) TO (10-6). EPA USES (10-6) AS A "POINT OF DEPARTURE" FOR SELECTING ACCEPTABLE LEVELS OF PROTECTIVENESS. BECAUSE THE RISK ASSOCIATED WITH EXPOSURE TO BACKGROUND CONCENTRATIONS EXCEED THE (10-5) RISK LEVEL, EPA HAS SELECTED (10-4) AS AN ACCEPTABLE LEVEL OF PROTECTIVENESS FOR THE WHITEWOOD CREEK SITE. (10-4) WAS USED BY EPA AS THE TARGET RISK FOR THE SELECTION OF AN ACTION LEVEL FOR SITE REMEDIATION.

AS A RESULT OF THE ASSESSMENT OF SITE RISK IN THE EA, EPA HAS DETERMINED THAT INGESTION OF DOWNGRADIENT AQUIFER GROUNDWATER 4 X (10-3) AND TAILINGS DEPOSIT SOILS 2.3 X (10-3) AS DEFINED IN THE MAXIMUM EXPOSED RESIDENT PROVIDES AN UNACCEPTABLE RISK TO FUTURE RESIDENTS. IN ADDITION, EXPOSURE THROUGH THE INGESTION OF ALL SOILS 2.4 X (10-4) AS DEFINED IN THE REPRESENTATIVE RURAL RESIDENT SCENARIO FOR EXISTING RESIDENTS IS DETERMINED TO NOT BE PROTECTIVE OF PUBLIC HEALTH. RISK ASSOCIATED WITH THE EXPOSURE AS DESCRIBED IN THE RECREATION VISITOR SCENARIO IS WITHIN THE ACCEPTABLE RISK RANGE FOR THE SITE. THE GREATEST NON-CARCINOGENIC RISKS ARE TO THE MAXIMUM EXPOSED SITE RESIDENT AND REPRESENTATIVE CHILD RESIDENT (TABLE A-4) FROM INGESTION OF DOWNGRADIENT ALLUVIAL GROUNDWATER AND TAILINGS DEPOSIT SOILS. RECREATIONAL VISITORS AND REPRESENTATIVE SITE RESIDENTS ARE NOT CONSIDERED TO BE EXPOSED TO EXCESSIVE NON-CARCINOGENIC RISKS. IN ALL SCENARIOS, ARSENIC IS THE METAL OF GREATEST CONCERN.

BASED ON THE FINDINGS OF THE EA, RESPONSE OBJECTIVES FOR THE SOILS AND ALLUVIAL GROUNDWATER WERE IDENTIFIED. THE RESPONSE OBJECTIVES FOR SOIL REMEDIATION AT WHITEWOOD CREEK ARE TO CONTROL EXPOSURE THROUGH INGESTION OF CONTAMINATED TAILINGS DEPOSIT SOILS, ALLUVIAL SOILS AND RESIDENTIAL SOILS, OR DOWNGRADIENT ALLUVIAL GROUNDWATER. TARGET CLEANUP OBJECTIVES FOR GROUNDWATER ARE THE MAXIMUM CONTAMINANT LEVELS. TARGET CLEAN-UP OBJECTIVES FOR SOILS WERE DEVELOPED BASED ON SOIL CONCENTRATIONS WHICH CORRESPOND TO CARCINOGENIC HEALTH RISKS OF 1 X (10-4). ACCEPTABLE CONTAMINANT LEVELS FOR THE CHEMICAL OF CONCERN (ARSENIC) IN RESIDENTIAL SOILS ARE 100 MG/KG, BASED ON THE 1 X (10-4) TARGET RISK LEVELS DERIVED IN THE ENDANGERMENT ASSESSMENT. THIS ACTION LEVEL WOULD ALSO REDUCE NON-CARCINOGENIC RISK TO AN ACCEPTABLE LEVEL. A SUMMARY OF THESE CALCULATIONS IS PROVIDED IN APPENDIX B OF THIS DOCUMENT.

ENVIRONMENTAL RISKS

SURFACE WATER: REMEDIAL INVESTIGATION STUDIES COMPLETED PRIOR TO INSTALLATION OF HOMESTAKE'S WASTEWATER TREATMENT PLANT INDICATE THAT ENVIRONMENTAL POPULATIONS OF RECREATIONAL OR COMMERCIAL SIGNIFICANCE WERE NOT AT RISK AT OR NEAR THE SITE. THE FOX STUDY, FOR EXAMPLE, REPORTED 16

NON-GAME SPECIES OF FISH AND A VARIETY OF INVERTEBRATES IN THE WATERS PRIOR TO INSTALLATION OF HOMESTAKE'S WASTEWATER TREATMENT PLANT. THE FS ASSUMED THAT THE IMPROVED QUALITY OF THE TREATED WATER OBSERVED FOLLOWING THE INSTALLATION OF THE PLANT RESULTED IN AN IMPROVED HABITAT IN WHITEWOOD CREEK.

HIGH DISCHARGE EVENTS IN THE PAST TEN YEARS HAVE RESULTED IN SOME INCREASE IN ARSENIC LOADING TO THE STREAM FROM EROSION OF CUTBANKS AND EXPOSED TAILINGS MATERIALS. IN MOST AREAS, HOWEVER, THE STREAM BED CURRENTLY HAS INCISED BELOW THE LEVEL OF THE TAILINGS, DECREASING THE EROSIONAL CAPACITY OF NORMAL STREAM FLOW. IT IS ANTICIPATED THAT ANNUAL FLOOD EVENTS MIGHT HAVE A TEMPORARY EFFECT ON THE QUALITY OF THE STREAM. IN ADDITION, INFREQUENT LARGER FLOOD EVENTS PROBABLY WOULD RESULT IN THE REDISTRIBUTION OF SOME TAILINGS DEPOSIT MATERIALS, BUT THE VOLUMES OF MATERIAL MOST LIKELY WOULD NOT BE LARGE.

WHITEWOOD CREEK BELOW THE CROOK CITY BRIDGE IS DESIGNATED BY THE STATE OF SOUTH DAKOTA AS A WARMWATER, SEMI-PERMANENT FISHERY, AND MEETS THE STATE CRITERIA FOR THIS USE (FEW TOXIC CONTAMINANTS ARE INCLUDED IN THE CRITERIA). THE LEVELS OF DISSOLVED ARSENIC AT THE DOWNSTREAM END OF THE SITE HAVE APPROACHED THE CRITERIA ESTABLISHED BY THE EPA FOR CHRONIC TOXICITY TO AQUATIC LIFE OF 0.190 MG/L. EPA WATER QUALITY CRITERIA AND THE CRITERIA FOR THE STATE OF SOUTH DAKOTA ARE BASED ON PROTECTIVENESS TO THE AQUATIC HABITAT. SINCE THESE LEVELS ARE NOT EXCEEDED, IT IS ASSUMED THAT THE AQUATIC HABITAT IS CURRENTLY NOT THREATENED OR ENDANGERED. HOWEVER, BECAUSE THE CURRENT RELEASE OF ARSENIC INTO THE SURFACE WATER IS UNCONTROLLED, THERE IS A POSSIBILITY OF EXCEEDANCES OF THESE CRITERIA IN THE FUTURE. MONITORING OF SURFACE WATER QUALITY IS THEREFORE PART OF EPA'S SELECTED REMEDY FOR THIS SITE. TABLE A-3 AND A-4 VEGETATION: TWO MAJOR TYPES OF RIPARIAN PLANT COMMUNITIES ARE PRESENT ALONG WHITEWOOD CREEK. THE SOUTHERN PORTION IS DOMINATED BY BUR OAK, WHILE THE NORTHERN PORTION, WITH SHALLOWER GRADIENT AND WIDER FLOODPLAIN, IS DOMINATED BY COTTONWOOD AND WILLOW. ALTHOUGH SOME OF THE TAILINGS DEPOSITS REMAIN BARREN, AN ABUNDANT PLANT COMMUNITY WITH LIMITED DIVERSITY HAS GRADUALLY COLONIZED THE TAILINGS OVER THE YEARS. THE SUCCESSION APPEARS TO BEGIN WHEN GRASSES TAKE ROOT IN LEAF LITTER TRAPPED IN DEPRESSIONS IN THE SURFACE OF THE TAILINGS. SOME TREES IN THE TAILINGS DEPOSITS HAVE BEEN DATED AT OVER 100 YEARS OLD.

SOME NATIVE PLANTS GROWING ON THE TAILINGS DEPOSIT AREAS CONTAIN CONCENTRATIONS OF ARSENIC ABOVE THAT OF VEGETATION FROM THE REFERENCE AREA. IT APPEARS HOWEVER, THAT ARSENIC IS ONLY ONE OF THE LIMITING FACTORS FOR ESTABLISHING A NORMAL PLANT COMMUNITY ON THE TAILINGS DEPOSITS. OTHER FACTORS SUCH AS THE PRESENCE OF OTHER MINERALS, CLAY CONTENT, SOIL PH AND PERMEABILITY MAY ACT INDEPENDENTLY IN RESTRICTING GROWTH, OR MAY CONTROL THE PHYTOTOXICITY OF ARSENIC IN THIS ENVIRONMENT.

OTHER SPECIES: AN INFORMAL SURVEY OF SITE RESIDENTS INDICATES THAT DEER, TURKEY, GROUSE AND OTHER WILDLIFE ARE COMMON IN THE AREA. A FIELD SURVEY FOR THREATENED OR ENDANGERED SPECIES IS PRESENTLY UNDERWAY.

#DA

VI. DESCRIPTION OF ALTERNATIVES

NINE REMEDIAL ALTERNATIVES (SEE TABLE A-5) WERE INITIALLY IDENTIFIED IN THE FS TO ADDRESS THE PUBLIC HEALTH RISK AT THE WHITEWOOD CREEK SUPERFUND SITE DOCUMENTED IN THE EA.

THE REMEDIAL ACTION OBJECTIVES IDENTIFIED BY EPA REGION VIII ARE:

- PREVENT INGESTION BY SITE RESIDENTS OF SURFACE SOILS OF THE TAILINGS DEPOSIT AREAS THAT WOULD POSE A POTENTIAL EXCESS LIFETIME CANCER RISK FROM THE INTAKE OF ARSENIC WHICH, WHEN COMBINED WITH THE POTENTIAL EXCESS LIFETIME CANCER RISKS POSED BY ARSENIC INTAKE FROM THE INGESTION OF SURFACE SOILS FROM OTHER AREAS WITHIN THE SITE, WOULD EXCEED 1 X (10-4). AS NOTED IN THE EA, GIVEN THE UNCERTAINTIES INHERENT IN DETERMINING THE FRACTIONS OF TAILINGS SOIL INGESTED BY INDIVIDUALS LIVING AT THE SITE, THIS REMEDIAL ACTION OBJECT SHOULD MITIGATE THE INCIDENTAL TAILINGS SOIL INGESTION TO JUSTIFY USE OF SMALLER INTAKE FRACTIONS FOR TAILING SOILS IN POST REMEDIATION RISK CALCULATIONS.

- PREVENT INGESTION, BY RESIDENTS OF THE SITE, OF RESIDENTIAL SURFACE SOILS HAVING AN AVERAGE ARSENIC CONCENTRATION THAT EXCEEDS 100 MG/KG.

- PREVENT INGESTION, BY RESIDENTS OF THE SITE, OF DRINKING WATER DRAWN FROM THE DOWNGRADIENT ALLUVIAL GROUNDWATERS HAVING AN AVERAGE CONCENTRATION OF ANY INORGANIC CONSTITUENT OTHER THAN SELENIUM THAT EXCEEDS THE MAXIMUM CONTAMINANT LEVEL FOR THAT CONSTITUENT SPECIFIED IN 40 CFR 141.11 (B) OF THE NATIONAL PRIMARY DRINKING WATER REGULATIONS.

- CONTINUE MONITORING THE WATER QUALITY AND FLOW OF WHITEWOOD CREEK AT THE SAMPLING STATIONS NEAR WHITEWOOD AND VALE.

THESE ALTERNATIVES WERE EVALUATED AND SCREENED BASED ON THREE CRITERIA: 1) EFFECTIVENESS TO ACHIEVE THE REMEDIAL ACTION OBJECTIVE, 2) IMPLEMENTABILITY, AND 3) COST. AS A RESULT OF THIS SCREENING, SIX ALTERNATIVES WERE CONSIDERED FOR DETAILED EVALUATION. THESE SIX ALTERNATIVES (1, 4, 4A, 5, 7 AND 9) ARE DESCRIBED BELOW.

FOR ALL CASES, EXCEPT THE "NO ACTION" ALTERNATIVE, IT WOULD BE NECESSARY TO REFINE KNOWLEDGE OF THE EXTENT OF THE 100-YEAR FLOODPLAIN OF WHITEWOOD CREEK AND DETERMINE THE EXTENT OF TAILINGS DEPOSITS AND AREAS WHERE SURFACE SOIL (UP TO 2 FEET BELOW SURFACE) CONTAIN GREATER THAN 100 MG/KG OF ARSENIC. THE ADOPTION OF INSTITUTIONAL CONTROLS, DESIGNED TO MINIMIZE EXPOSURE OF SITE RESIDENTS TO SURFACE SOILS AT THE SITE CONTAINING ELEVATED ARSENIC CONCENTRATIONS, ARE AN INTEGRAL PART OF ALL ALTERNATIVES BUT THE "NO ACTION" ALTERNATIVE. ALL ALTERNATIVES WOULD RELY ON THE CONTINUANCE OF THE STATE REGULATION PROHIBITING THE INSTALLATION OF WATER SUPPLY WELLS IN THE ALLUVIAL AQUIFER WITHIN THE 100-YEAR FLOODPLAIN IN ORDER TO PREVENT EXPOSURE OF SITE RESIDENTS TO CONTAMINATED GROUNDWATER. ALL OPTIONS EXCEPT ALTERNATIVE 9 WOULD REQUIRE THAT A PUBLIC HEALTH AND ENVIRONMENTAL EVALUATION BE CONDUCTED EVERY FIVE YEARS. TABLE A-5.

ALTERNATIVE 1: NO ACTION

THE NO ACTION ALTERNATIVE WOULD CONSIST OF NO REMEDIAL ACTIVITIES.

THE CURRENT STATE OF SOUTH DAKOTA BAN ON CONSTRUCTION OF WATER SUPPLY WELLS WITHIN THE 100-YEAR FLOODPLAIN OF WHITEWOOD CREEK BETWEEN THE CROOK CITY BRIDGE AND THE CONFLUENCE WITH THE BELLE FOURCHE RIVER WOULD CONTINUE TO BE ENFORCED (SOUTH DAKOTA WATER RIGHTS RULES, SECTION 74:02:04:26). THIS REGULATION PROHIBITS CONSTRUCTION OF WELLS THAT SUPPLY WATER TO THE PUBLIC OR SUPPLY WATER FOR HOUSEHOLD DOMESTIC USE OR FOR AGRICULTURAL PURPOSES. A VARIANCE IS ALSO PROVIDED FOR IN THIS REGULATION WHICH MAY BE GRANTED, IF IT IS SHOWN THAT A WELL IN THIS LOCATION WILL NOT BE CONTAMINATED FROM TAILINGS DEPOSITS AND WILL NOT CAUSE GROUNDWATER POLLUTION. A PUBLIC HEALTH AND ENVIRONMENTAL EVALUATION WOULD BE CONDUCTED EVERY FIVE YEARS.

ALTERNATIVE 4: INSTITUTIONAL CONTROLS WITH COVERING AND/OR REMOVING SURFACE SOILS AT RESIDENTIAL PROPERTIES (INCLUDING THE RESTRICTION OF FUTURE DEVELOPMENT)

TWO ACTIVITIES REQUIRED TO REFINE KNOWLEDGE OF THE EXTENT OF SITE CONTAMINATION AND DEFINE SITE BOUNDARIES WOULD BE COMPLETED DURING REMEDIAL DESIGN. A SURVEY WOULD BE CONDUCTED TO DEFINE THE LIMITS OF THE 100-YEAR FLOODPLAIN. SOIL WOULD BE SAMPLED BOTH AT THE SURFACE AND AT DEPTH TO DEFINE THE TAILING DEPOSIT AREAS AND PARCELS OF LAND WITH SURFACE SOILS ARSENIC CONCENTRATIONS GREATER THAN 100 MG/KG. MAPS COMPILED DURING THESE ACTIVITIES WILL BE USED TO SUPPORT THE COUNTY ORDINANCES REGARDING USE OF TAILINGS DEPOSITS AND FRINGE AREAS. ALL RESIDENTIAL PROPERTIES WITHIN THE SITE WHICH POTENTIALLY CONTAIN SOILS WITH ARSENIC CONCENTRATIONS GREATER THAN 100 MG/KG AS DEFINED BY THIS INITIAL SAMPLING OF SOILS WOULD ALSO BE SAMPLED.

TO DEFINE THE BOUNDARIES OF THE TAILINGS DEPOSIT AREAS ON BOTH SIDES OF THE CREEK, TRANSECT LINES PERPENDICULAR TO AND AT SELECTED INTERVALS ALONG A BASELINE CONNECTING THE CROOK CITY BRIDGE TO THE POINT WHERE WHITEWOOD CREEK JOINS THE BELLE FOURCHE RIVER WOULD BE LAID OUT ON A MAP AND IN THE FIELD. PARALLEL BASELINES MAY BE UTILIZED AS NEEDED TO ACCOMMODATE LOCAL OBSTRUCTIONS. SURFACE SOIL MEASUREMENTS OF, OR SAMPLES FOR THE ANALYSIS OF, TOTAL ARSENIC WOULD BE TAKEN ALONG EACH OF THESE TRANSECT LINES NEAR THE APPROXIMATE BOUNDARIES OF THE TAILINGS DEPOSIT AREAS ON EITHER SIDE OF THE CREEK AND AT INTERVALS AS REQUIRED TO IDENTIFY THE EXTENT OF SOILS WITH ARSENIC CONCENTRATIONS GREATER THAN 100 MG/KG. THE SAMPLE LOCATIONS AND ASSOCIATED ANALYTICAL RESULTS WOULD BE PLOTTED ON A MAP TO DEFINE THE BOUNDARIES OF THE TAILINGS DEPOSIT AREAS.

TAILINGS DEPOSITS WILL BE IDENTIFIED BY A STATISTICALLY SIGNIFICANT CHANGE IN THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE SURFACE SOLIDS. THESE PARAMETERS MAY INCLUDE, BUT NOT BE

LIMITED TO, COLOR, PARTICLE SIZE, GRAIN SIZE DISTRIBUTION AND ARSENIC CONCENTRATION.

TO DEFINE THE LOCATIONS AND BOUNDARIES OF THOSE PARCELS OF LAND OUTSIDE AND ON THE FRINGES OF THE TAILINGS DEPOSIT AREAS THAT HAVE SURFACE SOILS ARSENIC CONCENTRATIONS GREATER THAN 100 MG/KG, SAMPLE MEASUREMENTS OR SAMPLES OF THE TOP ONE INCH AND AT SIX INCHES BELOW THE SURFACE OF SOILS WOULD BE TAKEN ALONG (OR PARALLEL TO) EACH OF THE TRANSECT LINES DESCRIBED IN THE PREVIOUS SUBSECTION. THESE ARSENIC MEASUREMENTS OR SOIL SAMPLES WOULD BE TAKEN AT INTERVALS BEYOND THE APPARENT BOUNDARY OF THE TAILINGS DEPOSIT AREAS UNTIL ARSENIC CONCENTRATIONS AT OR BELOW 100 MG/KG WERE DETECTED.

THE SURVEY TO DEFINE THE LIMITS OF THE 100-YEAR FLOODPLAIN WOULD START WITH GROUND TRUTHING OF EXISTING AERIAL PHOTOGRAPHS AND MAPS INCLUDING FEDERAL EMERGENCY MANAGEMENT AUTHORITY (FEMA) MAPS. THE OBJECTIVE OF THIS TASK IS TO ANALYZE THE POTENTIAL FOR REDISTRIBUTION OF EXISTING TAILINGS DEPOSITS DURING MAJOR FLOOD EVENTS BY IDENTIFYING SEGMENTS WHERE FLOOD EVENTS MAY RESULT IN SIGNIFICANT EROSION AND/OR DEPOSITION.

AREAS AROUND THE RESIDENTIAL PROPERTIES WITH GREATEST POTENTIAL EXPOSURE TO ARSENIC CONCENTRATIONS EXCEEDING 100 MG/KG IN THE SURFACE SOILS WOULD BE REMEDIATED AS SUBSEQUENTLY DESCRIBED. IF THE ARSENIC LEVEL EXCEEDS 100 MG/KG WITHIN A DEFINED PARCEL AROUND EACH OF THE POTENTIALLY AFFECTED RESIDENCES, THE PROPERTY WOULD BE SUBJECTED TO REMEDIATION AS DESCRIBED BELOW.

THE PARCEL AROUND EACH OF THE RESIDENCES WILL BE BASED ON THE MOST ACTIVELY USED PORTION OF THE PROPERTY INCLUDING THE IMMEDIATE YARD (NON-GARDEN) AROUND THE RESIDENCE, THE DRIVEWAY AND GARDEN AREAS. THE BOUNDARIES OF EACH OF THE RESIDENTIAL PARCELS AND THE SUBAREAS WITHIN EACH PARCEL WOULD BE DETERMINED DURING RD/RA, AND MUST BE COORDINATED WITH THE CURRENT RESIDENT(S). THESE AREAS WOULD BE DETAILED ON A RESIDENTIAL SITE MAP AS PART OF THE SITE PLAN FOR EACH PROPERTY. IT IS ASSUMED THAT THE RESIDENTIAL PARCELS WILL BE APPROXIMATELY TWO ACRES, AND THAT GARDENS WILL BE APPROXIMATELY 90 FEET BY 180 FEET. IF USE PATTERNS EXCEED THIS AREA, THEN UP TO 8 ACRES AND 2 ACRES RESPECTIVELY WILL BE REMEDIATED. IF THE RESIDENTIAL PROPERTY IS LESS THAN TWO ACRES, THE ENTIRE PARCEL, REGARDLESS OF SIZE, WOULD BE REMEDIATED IF THE ARSENIC LEVELS AS DETERMINED FROM THE SAMPLING EXCEED 100 MG/KG.

A LIMITED NUMBER OF RANDOM SAMPLES WOULD BE COLLECTED FROM DRIVEWAYS AND RESIDENTIAL SOILS AT ANY OF THE TWENTY-TWO RESIDENCES WHICH WERE WITHIN THE RI STUDY AREA BUT ARE OUTSIDE THE 100 MG/KG ISOPLETH. IF ANY SAMPLE CONTAINS SURFACE SOIL CONCENTRATIONS GREATER THAN 100 MG/KG ARSENIC, THEN A RESIDENTIAL PARCEL WOULD BE SELECTED FOR SAMPLING AS OUTLINED ABOVE AND REMEDIATED AS REQUIRED.

AT THE RESIDENTIAL PARCEL SUBJECT TO POTENTIAL REMEDIATION, A GARDEN AREA DESIGNATED FOR FOOD PRODUCTION WOULD BE IDENTIFIED ON THE RESIDENTIAL SITE MAP ALONG WITH DRIVEWAYS, BUILDINGS AND OTHER PHYSICAL FEATURES. THE RESIDENTIAL AREA WOULD BE DIVIDED INTO A GRID WITH THE LINE SPACINGS SET AT 30 FEET. EACH OF THE 900 SQUARE FOOT AREAS DEFINED BY THE GRID LINES WOULD BE SAMPLED TO DETERMINE THE ARSENIC LEVEL AT THE SURFACE AND THE SIX INCH DEPTH. THE TWO SAMPLES FOR ANALYSIS FROM EACH 900 SQUARE FOOT AREA (SURFACE AND SUBSURFACE) WOULD BE A COMPOSITE OF THE LESS THAN 2 MM SIZE FRACTION FROM EACH OF THE FOUR QUADRANTS OF THE AREA. IF ANY OF THE SAMPLES FROM THE SURFACE OR SUBSURFACE EXCEED THE 100 MG/KG ARSENIC LEVEL, THEN THAT 900 SQUARE FOOT AREA WOULD BE SUBJECTED TO REMEDIATION.

SAMPLES COLLECTED DURING THE RI/FS INDICATE THAT WHERE RESIDENTIAL SOILS ARE CONTAMINATED, ARSENIC CONCENTRATIONS ARE ABOVE 100 MG/KG IN THE TOP TWELVE INCHES OF SOIL. SAMPLES TAKEN FROM EIGHTEEN AND TWENTY-FOUR INCH DEPTHS WERE AT BACKGROUND LEVELS. IT IS ASSUMED THAT IN THE NON-GARDEN AREAS WHERE NO INVASIVE ACTIVITIES OCCUR, TWELVE INCHES OF COVER WILL PROVIDE SUFFICIENT PROTECTION FOR THE RESIDENTS.

THE REMEDIATION OF THOSE NON-GARDEN YARD AREAS WHICH EXCEED THE 100 MG/KG ARSENIC LEVEL THEREFORE WOULD INVOLVE SOME COMBINATION OF THE FOLLOWING ACTIONS TO MINIMIZE EXPOSURE OF THE RESIDENTS TO CONTAMINATED SURFACE SOILS. 1) IF TOPOGRAPHY, BUILDING FOUNDATION LEVEL AND RESIDENT PERMIT, 12 INCHES OF SOIL COVER WOULD BE PLACED. 2) IF IT IS POSSIBLE TO MAINTAIN TOPOGRAPHY CONSISTENT WITH IMMEDIATELY ADJACENT AREAS, OR IF THE RESIDENT REQUESTS, THE REMOVAL OF TWELVE INCHES OF SOIL AND REPLACEMENT WITH TWELVE INCHES OF CLEAN SOIL MAY BE REQUIRED. 3) IF SURFACE SOIL ARSENIC CONCENTRATIONS OF LESS THAN 100 MG/KG CAN BE ACHIEVED BY REMOVING 6 INCHES OR LESS OF EXISTING SOIL, THIS WOULD BE DONE, AND SUFFICIENT CLEAN SOILS (20 MG/KG

ARSENIC) WOULD BE PLACED ON THE EXCAVATED AREAS. IN ANY OF THESE CASES, THE AREAS WOULD BE RESTORED TO THEIR FORMER VEGETATED CONDITIONS.

AS NOTED BELOW, EXCAVATION BELOW AREAS REMEDIATED WOULD BE PROHIBITED BY COUNTY ORDINANCE, UNLESS THE SOIL IS DEMONSTRATED TO CONTAIN LESS THAN 100 MG/KG ARSENIC.

IN GARDEN AREAS, THE INVASIVE AND MIXING ACTIVITIES ASSOCIATED WITH GARDENING COULD RESULT IN ELEVATED LEVELS OF ARSENIC BELOW THAT FOUND IN THE ADJACENT SOILS. TWENTY-FOUR INCHES OF SOIL WOULD THEREFORE BE REMOVED AND REPLACED WITH CLEAN SOIL FROM OFF-SITE SOURCES (LT 20 MG/KG ARSENIC).

ROADWAYS AND DRIVEWAYS AT EXISTING RESIDENTIAL PROPERTIES ARE PAVED WITH GRAVEL OR OTHER NON-ASPHALTIC, NON-CEMENT MATERIALS. WHERE THE SURFACE SOIL ARSENIC CONCENTRATIONS EXCEED 100 MG/KG, THESE GRAVELS WOULD BE CLEANED UP. SIX INCHES OF EXISTING GRAVEL WOULD BE REMOVED AND REPLACED WITH CLEAN IMPORTED GRAVEL OR ROAD BASE (LT 20 MG/KG ARSENIC).

CONTAMINATED SOIL AND GRAVEL WILL BE DISPOSED OF AT AN OFF-SITE FACILITY APPROVED BY EPA, SUCH AS THE GRIZZLY GULCH TAILINGS IMPOUNDMENT NEAR LEAD, SOUTH DAKOTA. UNDER SECTION 121(F)(3) OF CERCLA, ANY OFF-SITE DISPOSAL FACILITY USED MUST BE OPERATING IN COMPLIANCE WITH ALL APPLICABLE FEDERAL LAW AND STATE REQUIREMENTS. THE DISPOSAL WILL BE UNDERTAKEN IN COMPLIANCE WITH EPA POLICY AND/OR REGULATIONS GOVERNING OFF-SITE DISPOSAL OF CERCLA WASTE.

FOLLOWING REMOVAL AND/OR COVERING ACTIVITIES, COMPOSITE SOIL SAMPLES WOULD BE TAKEN AT ONE INCH AND AT ONE-HALF THE DEPTH OF SOIL OR GRAVEL COVER FROM ALL REMEDIATED AREAS IN THE MANNER PREVIOUSLY DESCRIBED, AND ANALYZED FOR TOTAL ARSENIC CONCENTRATIONS. SAMPLING DENSITY WILL BE SIMILAR TO THAT REQUIRED FOR PRE-REMEDIATION SAMPLING. THIS CONFIRMATION SAMPLING WOULD CONFIRM THAT ARSENIC LEVELS HAVE BEEN BROUGHT TO BELOW 100 MG/KG. SIMILAR SAMPLING AND ANALYSIS WOULD ALSO BE PERFORMED AFTER ANY FLOOD EVENT THAT RESULTED IN INUNDATION OF ANY RESIDENTIAL PROPERTY WITHIN THE SITE.

THE ARSENIC ANALYSIS OF SOILS AND OTHER MATERIAL AT THE SITE MAY BE PERFORMED USING AN EPA-APPROVED LABORATORY OR BY A COMBINATION OF LABORATORY AND FIELD ANALYSIS USING A PORTABLE X-RAY FLUORESCENCE (XRF) INSTRUMENT. THE USE OF FIELD-PORTABLE INSTRUMENTS WILL BE ACCEPTABLE AFTER DEVELOPMENT OF EPA-ACCEPTABLE QUALITY ASSURANCE/QUALITY CONTROL AND CALIBRATION AT AN ACCEPTABLE DETECTION LIMIT FOR THE CONCENTRATIONS BEING ANALYZED. IF SAMPLES ARE ANALYZED BY XRF IN THE FIELD, 15 PERCENT OF THE INITIAL CHARACTERIZATION AND CONFORMATIONAL SAMPLES WILL BE SPLIT AND SENT TO AN EPA-APPROVED ANALYTICAL LABORATORY TO CONFIRM THE FIELD RESULTS AND, FOR CONFORMATIONAL SAMPLES, THAT THE ARSENIC LEVELS ARE LESS THAN 100 MG/KG.

THE THREE COUNTIES INVOLVED, MEADE, BUTTE AND LAWRENCE, HAVE ALL EXPRESSED A WILLINGNESS TO ENACT CONTROLS SIMILAR TO THOSE OUTLINED IN APPENDIX D OF THE FEASIBILITY STUDY. THESE INSTITUTIONAL CONTROLS WOULD INCLUDE:

COUNTY ZONING AND BUILDING PERMIT REGULATIONS WOULD BE ADOPTED PROHIBITING RESIDENTIAL AND COMMERCIAL DEVELOPMENT WITHIN THE TAILINGS DEPOSIT AREAS AND PROHIBITING RESIDENTIAL DEVELOPMENT OF PROPERTIES THAT EXHIBIT SURFACE SOIL ARSENIC CONCENTRATIONS EXCEEDING 100 MG/KG.

COUNTY REGULATIONS WOULD BE ADOPTED PROHIBITING THE REMOVAL AND USE OF TAILINGS SOILS FROM THE TAILINGS DEPOSIT AREAS AND PROHIBITING DISTURBING REMEDIATED AREAS BELOW THE DEPTH OF SOIL REMOVAL/COVER UNLESS THE SOIL IS DEMONSTRATED TO CONTAIN LESS THAN 100 MG/KG ARSENIC. MINING OF THE TAILINGS DEPOSITS WOULD BE ALLOWED SUBJECT TO PERTINENT REGULATIONS OF THE STATE OF SOUTH DAKOTA.

EXCAVATION BELOW AREAS REMEDIATED WOULD BE PROHIBITED, UNLESS THE SOIL IS DEMONSTRATED TO CONTAIN LESS THAN 100 MG/KG ARSENIC.

AN EDUCATION PROGRAM WOULD BE CONDUCTED ANNUALLY TO ACQUAINT SITE RESIDENTS WITH THE POTENTIAL HEALTH HAZARDS ASSOCIATED WITH EXPOSURE TO THE TAILINGS SOILS AND DOWNGRADIENT ALLUVIAL GROUNDWATERS WITHIN THE SITE. THIS EDUCATION WOULD ALSO INCLUDE METHODS RESIDENTS CAN USE TO MINIMIZE INCIDENTAL INGESTION OF CONTAMINATED MATERIALS. A MECHANISM TO INFORM POTENTIAL PROPERTY OWNERS OF THE POTENTIAL HEALTH HAZARDS WILL ALSO BE INCLUDED IN THE EDUCATION PROGRAM.

IN THE EVENT OF A FLOOD WHERE CONTAMINATED MATERIALS POTENTIALLY WERE REDISTRIBUTED, THE FLOODED

AREAS WOULD BE RESAMPLED. ACTION WOULD BE TAKEN TO RETURN ANY NEWLY CONTAMINATED OR RE-CONTAMINATED AREAS TO POST-REMEDIATION CONDITIONS.

THE SURFACE WATER QUALITY OF WHITEWOOD CREEK WOULD BE MONITORED AT THE US GEOLOGICAL SURVEY SAMPLING STATIONS NEAR WHITEWOOD AND VALE FOUR TIMES A YEAR. THESE SAMPLING EVENTS WOULD BE CONDUCTED IN LATE WINTER BEFORE MAJOR SNOW-MELT RUNOFF; DURING PEAK RUNOFF IN SPRING; DURING THE LOW FLOW PERIOD IN LATE SUMMER; AND ONCE IMMEDIATELY FOLLOWING A MAJOR PRECIPITATION EVENT. CONTINUED MONITORING OF WHITEWOOD CREEK WATER QUALITY IS NEEDED TO EVALUATE THE EFFECT OF UNCERTAIN FUTURE RATES OF RELEASE OF ARSENIC FROM THE TAILINGS DEPOSITS ON THE ENVIRONMENT. THESE DATA WILL BE REVIEWED DURING THE FIVE-YEAR REVIEW.

THE RULES OF THE OCCUPATIONAL SAFETY AND HEALTH ACT WOULD APPLY TO THE CONSTRUCTION-TYPE ACTIVITIES CARRIED OUT TO REMOVE AND/OR COVER CONTAMINATED SOILS. IT IS ESTIMATED THAT IT WOULD TAKE 9 TO 18 MONTHS TO IMPLEMENT THE COVERING AND/OR REMOVAL COMPONENT OF THIS ALTERNATIVE.

A REVIEW OF SITE CONDITIONS (FIVE-YEAR REVIEW) WOULD BE REQUIRED EVERY FIVE YEARS TO ENSURE THAT HUMAN HEALTH AND THE ENVIRONMENT ARE BEING PROTECTED BY THE REMEDIAL ACTION BEING IMPLEMENTED. THIS WOULD INCLUDE, BUT NOT BE LIMITED TO:

VERIFICATION SAMPLING WITHIN THE REMEDIATED RESIDENTIAL AREAS.

A REVIEW OF DEVELOPMENT ACTIVITY WITHIN THE SITE. IF DEVELOPMENT HAS TAKEN PLACE WHICH IS INCONSISTENT WITH SPECIFICATIONS AS DESCRIBED IN EPA'S ROD, THESE PROPERTIES WOULD BE REQUIRED TO BE REMEDIATED IN A MANNER CONSISTENT WITH THE ROD.

A REVIEW OF THE EFFECTIVENESS OF THE EDUCATION PROGRAM IN ALERTING PRESENT AND POTENTIAL PROPERTY OWNERS TO CONCERNS RELATED TO THE CONTAMINATION WHICH REMAINS ON SITE.

A REVIEW OF COMPLIANCE WITH THE MONITORING WELL BAN IN THE FLOODPLAIN.

A REVIEW OF THE SURFACE WATER QUALITY DATA COLLECTED FROM WHITEWOOD CREEK TO ASSURE THAT LEVELS PROTECTIVE OF HUMAN HEALTH AND AQUATIC LIFE ARE BEING MAINTAINED.

ALTERNATIVE 4A: INSTITUTIONAL CONTROLS WITH COVERING AND/OR REMOVING OF SURFACE SOILS OF EXISTING RESIDENTIAL PROPERTIES (ALLOWING FUTURE DEVELOPMENT)

THIS ALTERNATIVE WOULD INVOLVE THE SAME ACTIVITIES AS ALTERNATIVE 4, BUT WOULD ALLOW FUTURE DEVELOPMENT WITHIN THE CONTAMINATED FRINGE AREAS OF THE 100-YEAR FLOODPLAIN OUTSIDE OF THE TAILINGS AREAS, FOLLOWING REMEDIATION TO PROVIDE CONDITIONS PROTECTIVE OF HUMAN HEALTH. THE COUNTY ORDINANCES TO BE ENACTED AS ADDITIONAL INSTITUTIONAL CONTROLS WOULD ALLOW FOR A VARIANCE IN WHICH AN APPROVAL OF PLAN FOR COVER AND/OR REMOVAL OF SOILS OF GREATER THAN 100 MG/KG WOULD BE REQUIRED BY THE SOUTH DAKOTA DEPARTMENT OF NATURAL RESOURCES PRIOR TO DEVELOPMENT OF THE LAND.

A VARIANCE PROCEDURE ALLOWING DEVELOPMENT ON LANDS WITHIN THE SITE (BUT OUTSIDE THE TAILINGS DEPOSIT AREAS), FOLLOWING APPROPRIATE REMEDIATION, WOULD BE ADOPTED. A VARIANCE PROCEDURE ALLOWING PUBLIC WORKS DEVELOPMENTS ON LAND INSIDE THE TAILINGS DEPOSIT AREAS, FOLLOWING APPROPRIATE REMEDIATION, WOULD ALSO BE ADOPTED.

A POTENTIAL DEVELOPER MUST SAMPLE THE SURFACE SOILS OF ANY PARCEL IN THE FRINGE AREA DETERMINED TO CONTAIN CONTAMINATED SOILS. THE SAMPLING PROGRAM WOULD BE SIMILAR TO THAT OUTLINED FOR RESIDENTIAL REMEDIATION IN ALTERNATIVE 4 TO IDENTIFY WHICH PORTIONS OF THE PARCEL CONTAIN CONCENTRATIONS OF ARSENIC GREATER THAN 100 MG/KG. THE DEVELOPER THEN WOULD SUBMIT SAMPLE RESULTS AND A REMEDIAL PLAN TO THE SOUTH DAKOTA DEPARTMENT OF NATURAL RESOURCES. THIS REMEDIAL PLAN WOULD DESCRIBE REMOVAL, COVER OR OTHER PROCEDURES FOR BRINGING ALL SURFACE SOILS TO 100 MG/KG AND WOULD INCLUDE PLANS FOR CONFIRMATORY SAMPLING.

AFTER APPROVAL OF THE PLAN, THE DEVELOPER MAY PERFORM THE WORK AND CONFIRMATORY SAMPLING. THE DEVELOPER WOULD ALSO ASSUME THE OBLIGATION OF COMPLYING WITH A COUNTY REGULATION PROHIBITING THE REMOVAL OR IMPAIRMENT OF ANY COVERS PLACED ON THE PARCEL UNDER THE PLAN UNLESS PRE-APPROVED BY THE STATE.

ALTERNATIVE 5: INSTITUTIONAL CONTROLS WITH FENCING OF TAILINGS DEPOSIT AREAS AND COVERING AND/OR REMOVING OF SURFACE SOILS OF EXISTING RESIDENTIAL PROPERTIES

THIS ALTERNATIVE WOULD INVOLVE THE SAME ACTIVITIES AS ALTERNATIVE 4 WITH THE ADDITION OF INSTALLATION OF FENCING AROUND THE PERIMETER OF THE TAILINGS DEPOSIT AREAS. A THREE-STRAND BARBED WIRE FENCE, OR EQUIVALENT, WOULD BE INSTALLED, USING EXISTING FENCING WHERE AVAILABLE. THE PURPOSE OF THE FENCE WOULD BE TO REDUCE CURRENT EXPOSURES OF SITE RESIDENTS TO THE ELEVATED SURFACE SOIL ARSENIC CONCENTRATIONS BY DISCOURAGING ACCESS TO THE TAILINGS DEPOSIT AREAS. ARARS WOULD BE THE SAME AS FOR ALTERNATIVE 4.

ALTERNATIVE 7: INSTITUTIONAL CONTROLS WITH PARTIAL SOIL COVER OF TAILINGS DEPOSIT AREAS AND COVERING AND/OR REMOVING OF SURFACE SOILS OF EXISTING CONTAMINATED RESIDENTIAL PROPERTIES

THIS ALTERNATIVE WOULD INVOLVE THE SAME ACTIVITIES AS ALTERNATIVE 4 WITH THE ADDITION OF PLACEMENT OF SOIL COVER OVER BARREN AREAS (I.E., DEVOID OF VEGETATION) IN THE TAILINGS DEPOSIT AREAS. BARREN AREAS WOULD BE IDENTIFIED BASED ON FIELD OBSERVATIONS AND REVIEW OF AERIAL PHOTOGRAPHS. IN THE PLACES WHERE THESE BARE AREAS FORM STEEP BANKS ALONG THE CREEK, THESE BANKS WOULD BE PEELED BACK TO CREATE BANKS HAVING SLOPES OF NO MORE THAN 1 HORIZONTAL TO 3 VERTICAL. THE PEELED-BACK TAILINGS MATERIALS WOULD BE PLACED IN LAYERS ON THE ADJOINING TAILINGS DEPOSITS BEFORE PLACEMENT OF THE SOIL COVER. SIX TO 12 INCHES OF NATIVE SOILS IMPORTED FROM OFF-SITE SOURCES WOULD BE SPREAD OVER THE BARREN AND/OR STABILIZED TAILINGS DEPOSITS. THIS COVER WOULD BE VEGETATED WITH NATIVE GRASSES TO STABILIZE IT AND MINIMIZE EROSION. IT IS ESTIMATED THAT APPROXIMATELY 700 ACRES (25 PERCENT) OF THE TAILINGS DEPOSITS ARE CANDIDATES FOR PARTIAL SOIL COVER.

PARTIAL COVER ACTIVITIES WOULD BE DESIGNED AND IMPLEMENTED TO COMPLY WITH THE OCCUPATIONAL SAFETY AND HEALTH REGULATIONS.

ALTERNATIVE 9: INSTITUTIONAL CONTROLS WITH REMOVAL OF TAILINGS DEPOSITS AREAS, AND ALLUVIAL TAILINGS FROM TAILINGS DEPOSIT AREAS, ON-SITE DISPOSAL OF TAILINGS, AND COVERING AND/OR REMOVING OF SURFACE SOILS OF EXISTING RESIDENTIAL PROPERTIES

THIS ALTERNATIVE WOULD INVOLVE THE SAME ACTIVITIES AS ALTERNATIVE 4 WITH THE ADDITION OF REMOVAL OF ALLUVIAL TAILINGS AND ON-SITE DISPOSAL OF THESE TAILINGS. THE SITE WOULD BE DIVIDED INTO EIGHT BLOCKS (SEGMENTS) FOR LOGISTICAL PURPOSES. AT EACH BLOCK, THE TAILINGS DEPOSITS WOULD BE REMOVED USING A FRONT-END LOADER AND TWO TRUCKS. THE EXCAVATED MATERIALS WOULD BE STOCKPILED PRIOR TO FEEDING THROUGH A SCREEN PLANT. THE SCREEN PLANT WOULD SEPARATE MATERIAL INTO THREE SIZE CATEGORIES: -24 MESH (ASSUMED TO BE ALL TAILINGS), -10 TO +24 MESH (ASSUMED TO BE MIXED TAILINGS AND ALLUVIUM) AND +10 MESH (ASSUMED TO BE ALLUVIUM). ALLUVIUM-SIZED MATERIAL WOULD BE WASHED AND RETURNED TO THE STREAM BED. TAILINGS AND MIXED MATERIAL WOULD BE HYDRAULICALLY TRANSPORTED TO AN ON-SITE TAILINGS IMPOUNDMENT. SIX INCHES OF NATIVE SOILS BROUGHT IN FROM AREAS OFF THE SITE WOULD BE PLACED OVER THE EXCAVATED AREAS, AND GRASS WOULD BE PLANTED TO STABILIZE THE SOILS AND MINIMIZE EROSION.

THE REMOVAL OF TAILINGS MATERIALS FROM THE TAILINGS DEPOSIT AREAS WOULD REQUIRE COMPLIANCE WITH THE OCCUPATIONAL SAFETY AND HEALTH ACT. CONSTRUCTION, USE AND POST-CLOSURE MAINTENANCE OF THE TAILINGS DEPOSIT FACILITY THAT WOULD BE EMPLOYED TO INTER THE TAILINGS WOULD REQUIRE COMPLIANCE WITH THE SOUTH DAKOTA SOLID WASTE RULES.

#SCA
VII. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

THIS SECTION PRESENTS A COMPARISON OF ALTERNATIVES USING NINE COMPONENT CRITERIA. THESE CRITERIA, WHICH ARE LISTED BELOW, ARE DERIVED FROM REQUIREMENTS CONTAINED IN SECTION 300.68 (H)(2) OF THE NATIONAL CONTINGENCY PLAN AND CERCLA SECTIONS 121(A) AND (B). TABLE A-6 CONTAINS A SUMMARY OF THE COMPARATIVE ANALYSIS.

1. PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT;
2. COMPLIANCE WITH ARARS;
3. REDUCTION OF TOXICITY, MOBILITY, OR VOLUME;
4. LONG-TERM EFFECTIVENESS AND PERMANENCE;
5. SHORT-TERM EFFECTIVENESS;
6. IMPLEMENTABILITY;

7. COST;
8. STATE ACCEPTANCE; AND
9. COMMUNITY ACCEPTANCE.

CRITERION 1: PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

ALL OF THE ACTION ALTERNATIVES WOULD PROVIDE SOME PROTECTION OF THE HEALTH OF SITE RESIDENTS. THE BAN ON USE OF THE ALLUVIAL AQUIFER, IF CONTINUED, WOULD PROTECT THE HEALTH OF RESIDENTS FROM THE IMPACTS OF INGESTING THESE GROUNDWATERS. REMOVING AND/OR COVERING SOILS OF EXISTING RESIDENTIAL PROPERTIES THAT HAVE SURFACE SOIL CONCENTRATIONS GREATER THAN 100 MG/KG ARSENIC WOULD REDUCE THE EXPOSURES OF THE RESIDENTS OF THESE PROPERTIES TO ACCEPTABLE LEVELS.

ALTERNATIVE 9 WOULD PROVIDE THE GREATEST AMOUNT OF OVERALL PROTECTIVENESS BECAUSE, IN ADDITION TO THE PROTECTION FROM ELEVATED RESIDENTIAL SOIL ARSENIC CONCENTRATIONS, IT WOULD ALSO REMOVE THE TAILINGS DEPOSITS PROVIDING PROTECTION FROM CONTACT WITH THESE MATERIALS IN THE FUTURE AND ALLOWING FOR EVENTUAL RESTORATION OF GROUNDWATER QUALITY. ALTERNATIVES 7 AND 9 WOULD ALLOW FOR PROTECTION OF THE ENVIRONMENT BY REMOVING TAILINGS DEPOSITS FROM ALONG WHITEWOOD CREEK. THIS WOULD DECREASE THE LOADING RATES OF CONTAMINANTS INTO THE SURFACE WATER, EROSION POTENTIAL, MIGRATION AND MOBILITY OF THE CONTAMINANTS AND THE CHANCE OF REDEPOSITING THE TAILINGS INTO THE ENVIRONMENT. HOWEVER, THIS ALTERNATIVE WOULD RESULT IN A MASSIVE ENVIRONMENTAL DISTURBANCE ALONG EIGHTEEN MILES OF WHITEWOOD CREEK, WHICH IS CURRENTLY A RELATIVELY STABLE ECOSYSTEM. REMOVAL OF THE CONTAMINATED ALLUVIUM WOULD ALSO DESTROY THE DOWNGRADIENT ALLUVIAL AQUIFER.

ALTERNATIVE 7 WOULD BE SOMEWHAT LESS EFFECTIVE THAN ALTERNATIVE 9, BUT SOMEWHAT MORE EFFECTIVE THAN ALTERNATIVES 4, 4A AND 5 BECAUSE BARE TAILINGS WHICH MAY POTENTIALLY BE INGESTED BY SITE RESIDENTS WOULD BE COVERED. THE ADDITION OF FENCING IN ALTERNATIVE 5 WOULD NOT BE MORE EFFECTIVE IN PROTECTING RESIDENTS FROM THE TAILINGS DEPOSITS. REMOVAL OF ADDITIONAL CONTAMINATED MATERIAL FOR FUTURE DEVELOPMENT IN ALTERNATIVE 4A COULD RESULT IN A SMALL INCREMENTAL LOSS OF EXPOSURE TO RESIDENTS.

UNDER THE NO ACTION ALTERNATIVE, NO REMEDIATION WOULD TAKE PLACE OTHER THAN CONTINUED ENFORCEMENT OF THE CURRENT STATE REGULATION PROHIBITING THE INSTALLATION OF WATER SUPPLY WELLS IN THE 100-YEAR FLOODPLAIN OF WHITEWOOD CREEK. BASED ON THE CHARACTERISTICS OF THE CONTAMINANTS PRESENT, THE RISKS TO HUMAN HEALTH AND THE ENVIRONMENT WOULD REMAIN AT THE UNACCEPTABLE LEVEL DESCRIBED IN THE ENDANGERMENT ASSESSMENT.

CURRENT EPA GUIDANCE REQUIRES THAT A PUBLIC HEALTH AND ENVIRONMENTAL EVALUATION BE CONDUCTED EVERY FIVE YEARS FOR ANY ALTERNATIVES IN WHICH HAZARDOUS SUBSTANCES, POLLUTANTS OR CONTAMINANTS REMAIN ON-SITE. THE FIVE-YEAR PUBLIC HEALTH AND ENVIRONMENTAL EVALUATIONS WOULD THEREFORE BE REQUIRED FOR ALL ALTERNATIVES EXCEPT ALTERNATIVE 9, AND WOULD ALLOW ASSESSMENT OF WHETHER FUTURE ACTION OR REMEDIATION WOULD BE REQUIRED. ANY PROBLEMS WITH PROTECTIVENESS IDENTIFIED IN THE FIVE-YEAR REVIEWS WILL BE ADDRESSED AT THAT TIME.

CRITERION 2: COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

DUE TO NATURE AND EXTENT OF CONTAMINATION, IT IS UNLIKELY THAT ANY ALTERNATIVE WOULD ACHIEVE COMPLIANCE WITH THE FOLLOWING CHEMICAL-SPECIFIC ARARS FOR THE DOWNGRADIENT ALLUVIAL GROUNDWATERS: THE NATIONAL PRIMARY DRINKING WATER STANDARDS AND THE STATE OF SOUTH DAKOTA DRINKING WATER STANDARDS WITH RESPECT TO ARSENIC AND OCCASIONALLY CADMIUM AND SELENIUM.

AS DISCUSSED IN SECTION IV THE SURFACE WATER OF WHITEWOOD CREEK WOULD NOT ACHIEVE COMPLIANCE WITH THE WATER QUALITY CRITERIA FOR THE PROTECTION OF HUMAN HEALTH FROM THE CONSUMPTION OF FISH WITH RESPECT TO ARSENIC FOLLOWING IMPLEMENTATION OF THESE ALTERNATIVES BECAUSE UPSTREAM SURFACE WATER EXCEEDS THIS CRITERION. HOWEVER, WHITEWOOD CREEK ENTERING THE SITE MEETS THE AQUATIC LIFE CRITERIA ESTABLISHED BY THE STATE FOR THIS SECTION OF THE CREEK AND THE WATER QUALITY CRITERIA FOR CHRONIC TOXICITY TO AQUATIC LIFE.

FOR ALL ACTION ALTERNATIVES, DURING THE REMOVAL AND/OR COVERING OF RESIDENTIAL SOILS OR TAILINGS DEPOSITS, COMPLIANCE MUST BE MAINTAINED WITH THE NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS AND THE SOUTH DAKOTA AMBIENT AIR QUALITY STANDARDS. THE RULES OF THE OCCUPATIONAL SAFETY AND HEALTH ACT WOULD APPLY TO THE ON-SITE ACTIVITIES CARRIED OUT DURING REMEDIAL DESIGN AND REMEDIAL ACTION. CONTINUED ENFORCEMENT OF THE RULE PROHIBITING THE INSTALLATION OF WATER SUPPLY WELLS WITHIN THE SITE WOULD CONTINUE TO ACHIEVE COMPLIANCE WITH THE

SOUTH DAKOTA WATER RIGHTS RULES.

THE ARCHAEOLOGICAL AND HISTORIC PRESERVATION ACT; NATIONAL HISTORIC PRESERVATION ACT; HISTORIC SITES, BUILDINGS AND ANTIQUITIES ACT; FISH AND WILDLIFE COORDINATION ACT; ENDANGERED SPECIES ACT; FLOODPLAIN MANAGEMENT; AND PROTECTION OF WETLANDS ARE ALL POTENTIALLY APPLICABLE FOR ALTERNATIVES 7 AND 9. A DEFINITIVE DETERMINATION OF THE POTENTIAL IMPACTS OF IMPLEMENTING THESE ALTERNATIVES WILL BE MADE IN THE DESIGN OF THIS REMEDIAL ACTION AND NECESSARY STEPS TAKEN TO ACHIEVE COMPLIANCE.

CRITERION 3: REDUCTION OF TOXICITY, MOBILITY, OR VOLUME

ALTERNATIVE 9 WOULD ACHIEVE THE MOST SIGNIFICANT REDUCTION IN MOBILITY OF ARSENIC FROM TAILINGS DEPOSITS AND CONTAMINATED ALLUVIUM FROM ALONG WHITEWOOD CREEK BY THE REMOVAL OF THESE MATERIALS TO AN IMPOUNDMENT. NO REDUCTION IN TOXICITY OR VOLUME WOULD BE ACCOMPLISHED, HOWEVER. THERE WOULD ALSO BE LIMITED REDUCTION IN MOBILITY AND VOLUME OF ARSENIC IN SOILS ADJACENT TO RESIDENTIAL AREAS. ALTERNATIVE 7 WOULD ACHIEVE LIMITED REDUCTION OF THE MOBILITY AND VOLUME OF ARSENIC IN SOILS ADJACENT TO RESIDENTIAL AREAS. IT WOULD, IN ADDITION, ACHIEVE SOME REDUCTION IN MOBILITY OF ARSENIC FROM THE TAILINGS BY COVERING THE BARE AREAS OF THESE DEPOSITS.

ALTERNATIVES 4, 4A AND 5 WOULD ACHIEVE LIMITED REDUCTION OF THE MOBILITY AND VOLUME OF ARSENIC FROM SOILS ADJACENT TO RESIDENTIAL AREAS BY MOVING THE CONTAMINATED MATERIAL TO A SECURE STORAGE AREA. THE MAJORITY OF ARSENIC AT THE SITE IS CONTAINED IN TAILINGS DEPOSITS WHICH WOULD NOT INCUR ANY REDUCTION IN TOXICITY, MOBILITY, OR VOLUME UNDER THESE ALTERNATIVES.

UNDER THE NO ACTION ALTERNATIVE, NO REDUCTION OF TOXICITY, MOBILITY, OR VOLUME OF THE TAILINGS CONSTITUENTS ON SITE WOULD OCCUR.

CRITERION 4: LONG-TERM EFFECTIVENESS AND PERMANENCE

THE GREATEST REDUCTION IN RISK WOULD BE ACHIEVED BY ALTERNATIVE 9 THROUGH REMOVAL OF THE TAILINGS DEPOSITS FROM ALONG WHITEWOOD CREEK. THE ON-SITE DISPOSAL OF TAILINGS DEPOSITS WOULD BE CONSIDERED THE MOST EFFECTIVE REMEDY, BUT NOT A PERMANENT REMEDY BECAUSE THE POTENTIAL EXISTS FOR DISPOSAL FACILITY FAILURE. PARTIAL COVER OF EXPOSED TAILINGS IN ALTERNATIVE 7 WOULD PROVIDE SOME REDUCTION OF RISK BUT WOULD NOT BE CONSIDERED A PERMANENT REMEDY BECAUSE THE POTENTIAL EXISTS FOR COVER FAILURE.

THE REMOVAL/COVERING OF RESIDENTIAL SOILS IN ALL ACTION ALTERNATIVES WOULD ACHIEVE A RISK REDUCTION FROM EXPOSURE TO THESE SOILS. THIS WOULD NOT BE CONSIDERED A PERMANENT REMEDY FOR RESIDENTIAL SOIL CONTAMINATION IF ANY CONTAMINATION IS ALLOWED TO REMAIN.

THE INSTITUTIONAL CONTROLS PORTION OF ALTERNATIVES 4, 4A, 5 AND 7 WOULD ALLOW A REDUCTION OF RISK TO SITE RESIDENTS BY LIMITING EXPOSURE TO TAILINGS DEPOSITS. THE LONG TERM EFFECTIVENESS WOULD BE DEPENDENT ON THE LOCAL GOVERNMENT'S ABILITY TO ENACT, IMPLEMENT AND ENFORCE THESE CONTROLS. UNFORSEEN FUTURE COMMUNITY PRESSURE TO ALLOW UNRESTRICTED DEVELOPMENT IN THE AREA MAY RESULT IN THE LACK OF ENFORCEMENT OR REVOCATION OF THE PROPOSED ZONING CONTROLS.

THE ADDITION OF A DEVELOPMENT VARIANCE WOULD SLIGHTLY INCREASE THE EFFECTIVENESS AND PERMANENCE OF ALTERNATIVE 4A WHEN NEW AREAS ARE CLEANED UP PRIOR TO DEVELOPMENT. THE ADDITION OF FENCING IN ALTERNATIVE 5 IS NOT BELIEVED TO ADD TO THE LONG TERM EFFECTIVENESS OR PERMANENCE OF THIS ALTERNATIVE.

THE NO ACTION ALTERNATIVE WOULD NOT BE EFFECTIVE, AS NO ACTION IS BEING TAKEN TO REDUCE THE MAJOR RISK PATHWAYS. THE RESTRICTION ON USE OF THE WATER SUPPLY HAS BEEN ENFORCED SINCE 1985 AND IS LIKELY TO REMAIN AN ENFORCEABLE REGULATION.

CRITERION 5: SHORT-TERM EFFECTIVENESS

THE INSTITUTIONAL CONTROLS PORTION OF THE ACTION ALTERNATIVES WOULD PROVIDE SHORT-TERM EFFECTIVENESS IN THAT IT IS ANTICIPATED THAT INSTITUTIONAL CONTROLS WOULD BE IMMEDIATELY ENACTED, IMPLEMENTED AND ENFORCED. NO CONTAMINATED MATERIAL WOULD BE DISTURBED IN THIS PROCESS, THEREFORE THERE WOULD BE NO NEED TO PROTECT THE COMMUNITY, THE WORKERS OR THE ENVIRONMENT DURING IMPLEMENTATION.

THE REMOVAL/COVER PORTION OF THESE ALTERNATIVES WOULD ALSO BE IMPLEMENTED IN A SHORT PERIOD OF TIME SINCE CONTAMINATED MATERIALS IN THE RESIDENTIAL AREAS AVAILABLE FOR DIRECT EXPOSURE WOULD BE EXCAVATED AND/OR COVERED WITHIN A FEW MONTHS FROM BEGINNING OF ACTIVITY. MINOR IMPACTS TO THE SITE RESIDENTS, WORKERS AND THE ENVIRONMENT ARE ANTICIPATED WHILE EXCAVATION AND COVERING ARE UNDERWAY. IT IS ANTICIPATED THAT THESE EFFECTS CAN BE MITIGATED BY PROPER PLANNING AND USE OF PERSONAL PROTECTIVE EQUIPMENT ACCORDING TO OSHA REGULATIONS.

IMPLEMENTATION OF ALTERNATIVE 7 WOULD BEGIN IMMEDIATELY, BUT IT IS ANTICIPATED THAT IT WILL TAKE THREE YEARS TO FULLY IMPLEMENT. THIS ALTERNATIVE COULD RESULT IN SOME SHORT-TERM ADVERSE ENVIRONMENTAL IMPACTS DUE TO PHYSICAL DISTURBANCES WHILE IMPLEMENTING THE REMEDY. ALTERNATIVE 9 WOULD TAKE UP TO FIFTEEN YEARS TO FULLY IMPLEMENT. ALTHOUGH IT WOULD PROVIDE ADDITIONAL PROTECTION BY REMOVING AND CONTAINING THE TAILINGS, IT COULD RESULT IN SIGNIFICANT SHORT TERM ADVERSE ENVIRONMENTAL IMPACTS DUE TO THE EXTENSIVE PHYSICAL DISTURBANCE THAT WOULD BE INVOLVED IN THE EXCAVATION PROCESS TO IMPLEMENT THE REMEDY.

THE NO ACTION ALTERNATIVE IS NOT EFFECTIVE BECAUSE THIS ALTERNATIVE DOES NOTHING TO REDUCE THE MAJOR RISK PATHWAYS AT THE SITE. THE STATE REGULATION RESTRICTING CONSTRUCTION OF WATER SUPPLY WELLS IN THE SITE IS ALREADY IN PLACE, AND BECAUSE NO IMPLEMENTATION ACTIVITIES WOULD BE INVOLVED, THIS ALTERNATIVE WOULD BE IMMEDIATELY IMPLEMENTED.

CRITERION 6: IMPLEMENTABILITY

THE STATE REGULATION PROHIBITING THE INSTALLATION OF WATER SUPPLY WELLS WITHIN THE SITE IS CURRENTLY BEING IMPLEMENTED. THE NO ACTION ALTERNATIVE INCLUDES NO OTHER IMPLEMENTATION ACTIONS, THUS THIS ALTERNATIVE IS IMPLEMENTABLE.

DURING THE PUBLIC COMMENT PERIOD THE LOCAL GOVERNMENTS EXPRESSED THE WILLINGNESS AND ABILITY TO ENACT, IMPLEMENT AND ENFORCE INSTITUTIONAL CONTROLS AS RECOMMENDED. LAWRENCE COUNTY PRESENTLY HAS AN ORDINANCE IN PLACE RESTRICTING THE USE OF TAILINGS DEPOSIT SOILS. THE INSTITUTIONAL CONTROLS PORTION OF ALL ACTION ALTERNATIVES IS THEREFORE IMPLEMENTABLE. THE SKILLED WORKERS AND CONSTRUCTION EQUIPMENT NEEDED TO IMPLEMENT CLEAN UP ACTIVITIES IN THE ACTION ALTERNATIVES ARE READILY AVAILABLE SINCE REMOVAL, TRANSPORT AND DISPOSAL TECHNIQUES ARE COMMONLY USED IN NEARBY MINING OPERATIONS. ALTERNATIVE 5 INCLUDES FENCING, WHICH, WHERE POSSIBLE, WOULD INCLUDE THE USE OF EXISTING FENCES. OBTAINING RIGHT-OF-WAY FOR CONSTRUCTION OF NEW FENCES MAY PRESENT A PROBLEM WITH IMPLEMENTING THIS REMEDY.

ALTERNATIVES 7 AND 9 CAN BE READILY IMPLEMENTED FROM A TECHNICAL STANDPOINT. THESE ALTERNATIVES HAVE THE POTENTIAL FOR A SHORT-TERM IMPACT ON THE ENVIRONMENT DUE TO PHYSICAL DISTURBANCE IN THE EXCAVATION PROCESS. CONSTRUCTION ACTIVITIES THEREFORE WOULD REQUIRE AN EXTENSIVE COORDINATION EFFORT TO CONTROL ADVERSE IMPACT TO THE ENVIRONMENT.

CRITERION 7: COST

THE COST OF THE NO ACTION ALTERNATIVE WOULD BE $26,000, THE COST ESTIMATED FOR THE FIVE-YEAR PUBLIC HEALTH AND ENVIRONMENTAL EVALUATION. ALTERNATIVE 4 IS THE LEAST COSTLY, AND ALTERNATIVE 9 THE MOST COSTLY. ALL ACTION ALTERNATIVES EXCEPT 5 HAVE AN ESTIMATED HIGH CAPITAL COST AND LOW OPERATION AND MAINTENANCE (O&M) COST. ESTIMATED OPERATION AND MAINTENANCE ON THE FENCE OVER A THIRTY YEAR PERIOD ARE APPROXIMATELY EQUAL TO ESTIMATED COST OF ORIGINAL INSTALLATION.

ESTIMATED NET PRESENT VALUE COSTS, TOTAL CAPITAL COSTS AND ANNUAL O&M COSTS FOR EACH ALTERNATIVE FOLLOW. FOR SOME OPTIONS, CERTAIN CAPITAL COSTS ARE ASSUMED TO BE INCURRED OVER THE COURSE OF THE THIRTY YEAR PERIOD. NOT ALL ANNUAL O&M COSTS ARE INCURRED EVERY YEAR OF THE THIRTY YEAR PERIOD.

THE ESTIMATED COST FOR ALTERNATIVE 4 TO REMOVE/COVER CONTAMINATED SOILS AT EXISTING RESIDENCES IS $638,392 ($581,000 CAPITAL COSTS, $11,000 ANNUAL O&M COST). ALTERNATIVE 4A ADDS TESTING AND REMOVAL/COVER AT 15 ADDITIONAL RESIDENCES. COSTS ARE ESTIMATED TO BE $882,813 ($1,028,000 CAPITAL COSTS AND $12,000 ANNUAL O&M COST). ALTERNATIVE 5, WHICH IS SIMILAR TO 4 WITH THE ADDITION OF FENCING, IS ESTIMATED AT $1,345,841 ($981,000 CAPITAL COSTS AND $31,000 ANNUAL O&M COST). ALTERNATIVE 7, WHICH IS ALTERNATIVE 4 WITH THE ADDITION OF A PARTIAL SOIL COVER, IS ESTIMATED AT $5,605,254 ($5,471,000 CAPITAL COSTS AND $16,000 ANNUAL O&M COST). ALTERNATIVE 9 IS ESTIMATED AT $75,054,923 ($107,575,000 CAPITAL COSTS AND $36,000 ANNUAL O&M COSTS).

CRITERION 8: STATE ACCEPTANCE

THE STATE OF SOUTH DAKOTA CONCURS WITH THE SELECTION OF ALTERNATIVE 4A.

CRITERION 9: COMMUNITY ACCEPTANCE

PUBLIC COMMENTS THAT WERE RECEIVED INDICATED THAT THERE IS NO CONSENSUS ON WHAT PRESENTS THE BEST REMEDIAL ALTERNATIVE FOR THE ARSENIC CONTAMINATED MILL TAILINGS ALONG WHITEWOOD CREEK. SOME CITIZENS EXPRESSED THE OPINION THAT THE TAILINGS APPEARED TO PRESENT NO HEALTH HAZARD AND THAT THE NO ACTION ALTERNATIVE WAS THE BEST SOLUTION. AN EQUAL NUMBER FELT THAT THE TAILINGS POSE A HAZARD TO HUMAN HEALTH AND THE ENVIRONMENT THAT CAN ONLY BE MITIGATED BY COMPLETE REMOVAL (ALTERNATIVE 9). OTHER PEOPLE WERE IN FAVOR OF THE REMEDY PROPOSED BY EPA, WITH RESERVATIONS ABOUT THE POTENTIAL EFFECT OF THE REMEDY ON THE ECONOMICS OF THE COMMUNITY.

#SR
VIII. THE SELECTED REMEDY

ALTERNATIVE 4A: INSTITUTIONAL CONTROLS WITH COVERING AND/OR REMOVING OF SURFACE SOILS OF EXISTING RESIDENTIAL PROPERTIES (ALLOWING FUTURE DEVELOPMENT).

BASED UPON A REVIEW OF INFORMATION CONTAINED IN THE SITE ADMINISTRATIVE RECORD, EPA HAS DECIDED THAT THE MOST APPROPRIATE REMEDY FOR THE WHITEWOOD CREEK SUPERFUND SITE IS TO REMOVE AND/OR COVER CONTAMINATED RESIDENTIAL SOILS AND RESTRICT ACCESS TO CONTAMINATED TAILINGS AND GROUNDWATER BY USE OF INSTITUTIONAL CONTROLS. AS DESCRIBED IN SECTION IX BELOW, THIS REMEDY IS THE MOST PROTECTIVE ALTERNATIVE WHICH WOULD NOT HAVE ADVERSE EFFECTS TO THE ENVIRONMENT. IT ALSO PROVIDES THE GREATEST PROTECTION IN THE MOST COST-EFFECTIVE MANNER.

IT IS ESTIMATED THAT IT WOULD TAKE APPROXIMATELY 18 MONTHS TO IMPLEMENT INSTITUTIONAL CONTROLS AND REMOVE/COVER SURFACE SOILS OF EXISTING RESIDENTIAL PROPERTIES. IT IS ALSO ESTIMATED THAT 15 ADDITIONAL PROPERTIES WILL BE DEVELOPED THROUGH VARIANCE FROM COUNTY ORDINANCE OVER THE THIRTY YEAR PERIOD.

THE ESTIMATED NET PRESENT WORTH FOR THE SELECTED REMEDY IS $882,813 (TABLE A-7). CAPITAL COSTS TOTAL $1,028,000, $581,000 OF WHICH WILL BE SPENT DURING START-UP, $447,000 WHICH WILL BE INCURRED OVER THE THIRTY YEAR PERIOD. ANNUAL O&M COSTS ARE ESTIMATED TO BE $12,000.

AT EXISTING RESIDENCES EXHIBITING GREATER THAN 100 MG/KG ARSENIC IN SURFACE SOILS, THESE SOILS WOULD BE REMOVED AND/OR COVERED IN GARDEN, NON-GARDEN AND ROADWAY AREAS. ALL MATERIAL REMOVED WOULD BE PLACED IN A DISPOSAL FACILITY APPROVED BY THE STATE AND EPA WHICH IS DESIGNED AND CONSTRUCTED TO HOLD WASTES THAT ARE SIMILAR IN NATURE AND CONCENTRATION OF CONTAMINANTS. SOIL SAMPLING WOULD BE CONDUCTED BOTH ON THE SURFACE AND AT DEPTH FOLLOWING THIS REMEDIAL ACTION TO CONFIRM THAT REMEDIAL ACTION GOALS HAVE BEEN MET. ANY PROPERTIES DEVELOPED UNDER VARIANCE WOULD BE SAMPLED AND REMEDIATED IN A SIMILAR FASHION. IF REMEDIATED AREAS SHOULD BE FLOODED THESE AREAS WOULD BE RESAMPLED AND APPROPRIATE ACTION TAKEN TO RETURN ANY CONTAMINATED AREAS TO POST-REMEDIATION CONTAMINANT LEVELS. A FIVE-YEAR REVIEW WOULD BE PERFORMED FIVE YEARS AFTER REMEDIATION IS COMPLETED. SOUTH DAKOTA WATER RIGHTS RULES (SECTION 74:02:06:26) BAN ON WATER WELLS IN THE WHITEWOOD CREEK 100-YEAR FLOODPLAIN WOULD ALSO BE CONTINUED.

THE SCOPE AND PERFORMANCE OF THE REMEDY SELECTED IN THIS ROD ARE CONSISTENT WITH THE REMEDY PROPOSED AT THE START OF PUBLIC COMMENT BECAUSE THE ELEMENTS OF REMEDIAL ACTION TO BE IMPLEMENTED ARE THE SAME. IN RESPONSE TO COMMENTS RECEIVED FROM CITIZENS DURING THE PUBLIC COMMENT PERIOD, EPA HAS DECIDED WARNING SIGNS AND NOTICE IN DEED ARE NOT NECESSARY BECAUSE THE PROPOSED EDUCATIONAL PROGRAM IS DEEMED TO BE SUFFICIENT.

RESPONSE OBJECTIVES

THE RESPONSE OBJECTIVES FOR SOIL REMEDIATION AT WHITEWOOD CREEK ARE TO CONTROL EXPOSURE THROUGH INGESTION OF CONTAMINATED TAILINGS DEPOSIT SOILS, ALLUVIAL SOILS AND RESIDENTIAL SOILS, OR DOWNGRADIENT ALLUVIAL GROUNDWATER. TARGET CLEANUP OBJECTIVES FOR GROUNDWATER ARE THE MAXIMUM CONTAMINANT LEVELS. TARGET CLEAN-UP OBJECTIVES FOR SOILS WERE DEVELOPED BASED ON SOIL CONCENTRATIONS WHICH CORRESPOND TO CARCINOGENIC HEALTH RISKS OF 1 X (10-4). ACCEPTABLE CONTAMINANT LEVELS FOR THE CHEMICAL OF CONCERN (ARSENIC) IN RESIDENTIAL SOILS ARE 100 MG/KG, BASED ON THE 1 X (10-4) TARGET RISK LEVELS DERIVED IN THE ENDANGERMENT ASSESSMENT. THIS ACTION

LEVEL WOULD ALSO REDUCE NON-CARCINOGENIC RISK TO AN ACCEPTABLE LEVEL. A SUMMARY OF THESE CALCULATIONS ARE PROVIDED IN APPENDIX A OF THIS DOCUMENT.

#SD
STATUTORY DETERMINATIONS

EPA'S PRIMARY RESPONSIBILITY AT SUPERFUND SITES IS TO SELECT REMEDIAL ACTIONS THAT ARE PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT. IN ADDITION, SECTION 121 OF CERCLA PROVIDES SEVERAL OF THE FOLLOWING STATUTORY REQUIREMENTS AND PREFERENCES. CERCLA ALSO REQUIRES THAT THE SELECTED REMEDIAL ACTION FOR THE SITE MUST COMPLY WITH APPLICABLE OR RELEVANT AND APPROPRIATE ENVIRONMENTAL STANDARDS ESTABLISHED UNDER FEDERAL AND STATE ENVIRONMENTAL LAWS, UNLESS A WAIVER IS GRANTED. THE SELECTED REMEDY MUST ALSO BE COST-EFFECTIVE AND UTILIZE PERMANENT TREATMENT TECHNOLOGIES OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE. THE STATUTE ALSO CONTAINS A PREFERENCE FOR REMEDIES THAT PERMANENTLY OR SIGNIFICANTLY REDUCE THE VOLUME, TOXICITY, OR MOBILITY OF HAZARDOUS SUBSTANCES. THE FOLLOWING SECTIONS DISCUSS HOW THE SELECTED REMEDY FOR CONTAMINATED SOILS AT WHITEWOOD CREEK MEET THESE STATUTORY REQUIREMENTS.

PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

THE SELECTED REMEDY PROTECTS HUMAN HEALTH AND THE ENVIRONMENT THROUGH RESTRICTING ACCESS TO, AND USE OF, THE TAILINGS AND CONTAMINATED GROUNDWATER BY IMPLEMENTATION OF ORDINANCES. THIS REMEDY WOULD PERMANENTLY ELIMINATE THE INGESTION THREAT CURRENTLY POSED TO RESIDENTS FROM CONTAMINATED RESIDENTIAL SOILS. IT WOULD FURTHER LIMIT, BUT NOT ELIMINATE, EXPOSURE TO TAILINGS DEPOSITS. THE CANCER RISKS ASSOCIATED WITH THE RESIDENTIAL SOILS AND TAILINGS DEPOSITS AREAS WOULD THEREFORE BE REDUCED TO AN ACCEPTABLE LEVEL OF 1.0 X (10-4). THERE ARE SOME SHORT-TERM RISKS ASSOCIATED WITH THE SELECTED REMEDY DURING REMOVAL OF CONTAMINATED SOILS FROM RESIDENTIAL PROPERTIES, BUT THESE CAN BE MINIMIZED WITH PROTECTIVE AND PREVENTATIVE MEASURES. OF ALL THE ALTERNATIVES, THE SELECTED REMEDY PROVIDES THE BEST PROTECTION TO HUMAN HEALTH, WITHOUT SIGNIFICANT ADVERSE IMPACT TO THE ENVIRONMENT.

ATTAINMENT OF ARARS

CERCLA SECTION 121 REQUIRES SELECTION OF A REMEDIAL ACTION THAT IS PROTECTIVE OF HUMAN HEALTH AND THE ENVIRONMENT. THE DETERMINATION OF PROTECTIVENESS IS BASED ON COMPLIANCE OF THE SELECTED REMEDY WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS). APPENDIX C IS A LIST OF THE ARARS IDENTIFIED FOR THIS SITE WHICH APPLY TO THE SELECTED REMEDY.

APPLICABLE REQUIREMENTS ARE THOSE CLEANUP STANDARDS, STANDARDS OF CONTROL, AND OTHER SUBSTANTIVE REQUIREMENTS, CRITERIA, OR LIMITATIONS PROMULGATED UNDER FEDERAL OR STATE ENVIRONMENTAL OR FACILITY SITING LAW THAT SPECIFICALLY ADDRESS A HAZARDOUS SUBSTANCE, POLLUTANT, CONTAMINANT, REMEDIAL ACTION, LOCATION, OR OTHER CIRCUMSTANCE AT A CERCLA SITE.

RELEVANT AND APPROPRIATE REQUIREMENTS ARE THOSE CLEANUP STANDARDS, STANDARDS OF CONTROL, AND OTHER SUBSTANTIVE REQUIREMENTS, CRITERIA, OR LIMITATIONS PROMULGATED UNDER FEDERAL OR STATE ENVIRONMENTAL SITING LAW THAT, WHILE NOT "APPLICABLE" TO A HAZARDOUS SUBSTANCE, POLLUTANT, CONTAMINANT, REMEDIAL ACTION, LOCATION, OR OTHER CIRCUMSTANCE AT A CERCLA SITE, ADDRESS PROBLEMS OR SITUATIONS SUFFICIENTLY SIMILAR TO THOSE ENCOUNTERED AT THE CERCLA SITE THAT THEIR USE IS WELL SUITED TO THE PARTICULAR SITE.

AS DISCUSSED IN SECTION VII, THE SELECTED REMEDY WOULD NOT ACHIEVE COMPLIANCE WITH SOME CHEMICAL-SPECIFIC ARARS RELATED TO THE DOWNGRADIENT GROUNDWATER AND SURFACE WATER OF WHITEWOOD CREEK. FOR THE GROUNDWATER, THE RELEVANT AND APPROPRIATE REQUIREMENTS INCLUDE PRIMARY DRINKING WATER STANDARDS (40 CFR 141) AND THE DRINKING WATER STANDARDS FOR THE STATE OF SOUTH DAKOTA (ARSD:74:04:05). AS THESE WOULD NOT BE ATTAINED, A WAIVER IS INVOKED UNDER CERCLA SECTION 121(D)(4)(C) BECAUSE REMEDIATION OF THE GROUNDWATER WOULD BE TECHNICALLY IMPRACTICABLE AS DISCUSSED IN SECTION VII. THE CONTINUING ENFORCEMENT OF SOUTH DAKOTA REGULATIONS (ARSD 74:02:06:26) PROHIBITING USE OF THE DOWNGRADIENT AQUIFER WOULD PROVIDE ADEQUATE PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT.

THE SELECTED REMEDY WILL ALSO NOT ATTAIN THE SURFACE WATER ARARS INCLUDING AMBIENT WATER QUALITY CRITERIA (40 CFR 131) FOR THE CONSUMPTION OF FISH. AS THESE WOULD NOT BE ATTAINED, A WAIVER IS INVOKED UNDER CERCLA SECTION 121(D)(4)(C) BECAUSE CLEANUP OF THE SURFACE WATER IS TECHNICALLY IMPRACTICABLE BECAUSE THE WATER ENTERING THE SITE DOES NOT MEET THIS CRITERION AND BECAUSE OF

EXCEEDANCES ALLOWED UNDER SOUTH DAKOTA REGULATIONS (ARSD 74:03).

THE SELECTED REMEDY WOULD ADDRESS AND COMPLY WITH ALL LOCATION- AND ACTION-SPECIFIC ARARS FOR WORKER PROTECTION, ONSITE DUST EMISSIONS, PROTECTION OF HISTORIC AND NATURAL RESOURCES AND OTHER CRITERIA LISTED IN APPENDIX A.

COST EFFECTIVENESS

EPA BELIEVES THE SELECTED REMEDY IS COST-EFFECTIVE IN MITIGATING THE RISK POSED BY CONTAMINATED RESIDENTIAL SOILS AND TAILINGS DEPOSITS WITHIN A REASONABLE PERIOD OF TIME. THE SELECTED REMEDY EFFECTIVELY REDUCES EXPOSURE TO CONTAMINATION TO ACCEPTABLE LEVELS WHILE REMAINING COST-EFFECTIVE. PRESENT NET WORTH COSTS ASSOCIATED WITH ALTERNATIVE 4A ARE APPROXIMATELY $882,813.

UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

EPA ANALYZED THE ALTERNATIVES TO DETERMINE WHICH WOULD UTILIZE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE. THE SELECTED REMEDY WOULD ACHIEVE THE RESPONSE OBJECTIVES OF PREVENTING INGESTION OF SURFACE SOILS OF THE TAILINGS DEPOSITS AREAS, INGESTION OF CONTAMINATED RESIDENTIAL SOILS, AND INGESTION OF CONTAMINATED DOWNGRADIENT ALLUVIAL GROUNDWATERS. PERMANENT SOLUTIONS OR ALTERNATIVE TREATMENT TECHNOLOGIES ARE NOT FEASIBLE OR PRACTICAL FOR THE WASTES AT THIS SITE.

THIS REMEDY UTILIZES PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE FOR THIS SITE. HOWEVER, BECAUSE TREATMENT OF THE PRINCIPAL THREATS POSED BY THE SITE WAS NOT FOUND TO BE PRACTICABLE, THIS REMEDY DOES NOT SATISFY THE STATUTORY PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT. TREATMENT IS IMPRACTICABLE BECAUSE OF THE LARGE VOLUME OF CONTAMINATED SOILS AND TAILINGS DEPOSITS, THE LACK OF APPROPRIATE TREATMENT TECHNOLOGIES, AND THE POTENTIAL FOR ADVERSE ENVIRONMENTAL IMPACT.

PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

THE SELECTED REMEDY DOES NOT SATISFY THIS STATUTORY PREFERENCE. THE PRINCIPAL THREAT TO HUMAN HEALTH IS FROM ARSENIC-CONTAMINATED TAILINGS DEPOSITS AND ALLUVIAL GROUNDWATER. THERE ARE NO DEMONSTRATED AND AVAILABLE PROCESSES FOR THE TREATMENT OR REMOVAL OF ARSENIC FROM CONTAMINATED SOILS. WITHDRAWAL AND TREATMENT OF GROUNDWATER FOR REMOVAL OF ARSENIC IS ALSO A LARGELY UNTESTED METHOD AND PROBABLY WILL REQUIRE AN UNACCEPTABLY LONG TIME TO REACH DESIRABLE LEVELS OF CONTAMINANTS. SEE SECTION 4.0 ABOVE FOR FURTHER DISCUSSION. X.

#DSC
DOCUMENTATION OF SIGNIFICANT CHANGES

THE PROPOSED PLAN FOR THE WHITEWOOD CREEK SITE WAS RELEASED FOR PUBLIC COMMENT ON JANUARY 10, 1990. THE PROPOSED PLAN IDENTIFIED ALTERNATIVE 4A, INSTITUTIONAL CONTROLS AND REMOVAL/COVERING OF RESIDENTIAL SOILS, AS THE PREFERRED ALTERNATIVE. EPA REVIEWED ALL WRITTEN AND VERBAL COMMENTS SUBMITTED DURING THE PUBLIC COMMENT PERIOD. BASED UPON PUBLIC COMMENTS RECEIVED, THE FOLLOWING CHANGES HAVE BEEN MADE TO THE PREFERRED ALTERNATIVE:

1. THE DEFINITION OF THE SITE HAS BEEN CLARIFIED FROM THAT PUBLISHED IN THE PROPOSED PLAN. THE SITE'S SOUTHERN BOUNDARY IS THE CROOK CITY BRIDGE, NOT INTERSTATE HIGHWAY 90. THE CHARACTERISTICS OF THIS TWO-MILE STRETCH OF WHITEWOOD CREEK INCLUDED IN REMEDIAL INVESTIGATION STUDIES ARE SIMILAR TO WHITEWOOD CREEK DOWNSTREAM OF I-90 IN GRADIENT AND VOLUME OF TAILINGS DEPOSITS. THE AREA ALSO CORRESPONDS TO THE AREA OF THE ALLUVIAL WATER WELL BAN IN SOUTH DAKOTA RULES ARSD 74:02.

2. THE ALLOWANCE FOR A PUBLIC WORKS VARIANCE TO ALLOW CONSTRUCTION IN THE TAILINGS DEPOSIT AREAS HAS BEEN ADDED, IN RESPONSE TO LETTERS RECEIVED FROM THE STATE OF SOUTH DAKOTA AND CONCERNED CITIZENS.

3. WARNING SIGNS HAVE BEEN REMOVED FROM THE PLANNED EDUCATIONAL PROGRAM, BECAUSE EPA CONCURRED WITH COMMENTS AT THE PUBLIC MEETING THAT THESE SIGNS WOULD NOT SIGNIFICANTLY LOWER RISK TO SITE RESIDENTS.

4. NOTICE IN DEED RESTRICTIONS WILL NOT BE REQUIRED. AN ALTERNATIVE METHOD OF EDUCATING POTENTIAL PROPERTY OWNERS WILL BE INCLUDED IN THE EDUCATION PROGRAM.

5. THE AREA OF LAND PER RESIDENCE TO BE TESTED FOR CONTAMINATION AND CLEAN-UP IF NECESSARY WAS ESTIMATED IN THE PROPOSED PLAN TO BE TWO ACRES. LAND USE PATTERNS WILL BE USED TO SELECT THE APPROPRIATE AREA, WHICH IS EXPECTED TO BE TWO ACRES PER RESIDENCE, BUT MAY INCLUDE UP TO EIGHT ACRES IF REQUIRED TO BE PROTECTIVE OF THE HEALTH OF THE SITE RESIDENTS.

#RS

RESPONSIVENESS SUMMARY
WHITEWOOD CREEK SUPERFUND SITE

II. BACKGROUND ON COMMUNITY INVOLVEMENT

PRIOR TO THE ISSUANCE OF EPA'S PROPOSED PLAN FOR THE WHITEWOOD CREEK SUPERFUND SITE, THERE HAD NOT BEEN STRONG COMMUNITY INTEREST IN THE SITE. PRIOR TO, AND CONCURRENT WITH, THE LISTING OF THE SITE ON THE NATIONAL PRIORITIES LIST (NPL) OF HAZARDOUS WASTE SITES, AND AS A RESULT OF MANDATORY COMPLIANCE WITH EPA SURFACE WATER QUALITY AND DISCHARGE STANDARDS, HOMESTAKE HAS MADE MAJOR STRIDES IN RETURNING WHITEWOOD CREEK TO A CLEAR RUNNING STREAM WITH A VIABLE AQUATIC POPULATION. VEGETATION NOW ESTABLISHED ON THE TAILINGS DEPOSITS AREA SUPPORTS A WILDLIFE POPULATION.

HOMESTAKE HAS ENTERED INTO A JOINT VENTURE WITH GOLDSTAKE EXPLORATIONS INC. TO MINE THE TAILINGS ON THE SITE FOR GOLD, FOR WHICH MOST SITE RESIDENTS WILL RECEIVE ROYALTIES ON THEIR MINERAL RIGHTS. HOMESTAKE HAS BEEN ACTIVELY COMMUNICATING WITH SITE RESIDENTS FOR SEVERAL YEARS. HOMESTAKE HAS INFORMED THE CITIZENS THAT ACTIVITIES RELATED TO MINING OF THE WHITEWOOD CREEK TAILINGS, SUCH AS A REQUEST FOR MINE PERMITS, CANNOT BE INITIATED UNTIL EPA HAS MADE A DECISION REGARDING CLEANUP OF THE SITE. HOMESTAKE SPONSORED A MEETING IN WHITEWOOD ON JANUARY 24, 1990, TO DISCUSS POTENTIAL IMPACTS OF EPA'S PREFERRED REMEDY ON FUTURE MINING ACTIVITIES. SITE RESIDENTS AND INTERESTED PARTIES, AS WELL AS EPA REPRESENTATIVES, WERE INVITED. MOST CONCERNS EXPRESSED BY SITE RESIDENTS AT THIS MEETING WERE REITERATED AT EPA'S PUBLIC MEETING ON JANUARY 25,1990.

OVER THE PAST FEW YEARS, EPA HAS BEEN INVOLVED IN THE PROCESS OF DEVELOPING AN ENDANGERMENT ASSESSMENT FOR THE WHITEWOOD CREEK SUPERFUND SITE. IN THIS ASSESSMENT, EPA CONCLUDES THAT THE RISK POSED TO THE SITE RESIDENTS THROUGH INCIDENTAL INGESTION OF ARSENIC-CONTAMINATED SOIL IS SIGNIFICANT ENOUGH TO REQUIRE REMEDIATION OF SOILS AROUND RESIDENTIAL PROPERTIES. HOMESTAKE DOES NOT AGREE WITH EPA'S ASSESSMENT OF RISK POSED TO SITE RESIDENTS THROUGH INCIDENTAL INGESTION OF ARSENIC-CONTAMINATED SOIL. HOMESTAKE HAS EXPRESSED THIS VIEW TO SITE RESIDENTS, ALONG WITH HOMESTAKE'S CONCERN THAT EXCESSIVE EXPENDITURES ON REMEDIAL ACTION WILL LIMIT THE ECONOMIC VIABILITY OF THE MINING VENTURE.

BECAUSE OF THE STRONG RELIANCE ON INSTITUTIONAL CONTROLS IN THE SELECTED REMEDY, EPA HAS ACTIVELY SOLICITED INPUT FROM THE STATE AND COUNTIES INVOLVED AS THESE ENTITIES WILL HAVE PRINCIPAL CONTROL OVER ADOPTION AND ENFORCEMENT OF THE CONTROLS OUTLINED IN THE SELECTED REMEDY. MEETINGS WITH THESE AGENCIES ARE DISCUSSED IN GREATER DETAIL IN SECTION III OF THIS DOCUMENT, WHICH IS THE DECISION SUMMARY ATTACHMENT B TO THE RECORD OF DECISION (ROD) FOR THE WHITEWOOD CREEK SUPERFUND SITE. THESE RECENT ACTIVITIES, AND A GROWING INTEREST IN THE AREA REGARDING ENVIRONMENTAL CONCERNS, HAVE LED TO AN INCREASE IN COMMUNITY INVOLVEMENT.

III. SUMMARY OF PUBLIC COMMENTS AND AGENCY RESPONSES

A SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC MEETING COMMENTS RAISED DURING THE WHITEWOOD CREEK PUBLIC MEETING ARE SUMMARIZED BRIEFLY BELOW. THE PUBLIC MEETING WAS HELD ON JANUARY 25,1990. THE COMMENTS ARE CATEGORIZED BY RELEVANT TOPICS.

PUBLIC PARTICIPATION PROCESS

COMMENT #1: ONE RESIDENT SUGGESTED THAT EPA HAS NOT HELD ENOUGH PUBLIC MEETINGS.

EPA RESPONSE: EPA HAS HAD AN ACTIVE COMMUNITY INVOLVEMENT PROGRAM AT THE SITE. EPA HAS CONDUCTED INTERVIEWS WITH SITE RESIDENTS, COUNTY OFFICIAL AND STATE LEGISLATORS. AS A RESULT OF THESE CONVERSATIONS, EPA DETERMINED THAT IT WOULD NOT BE PRODUCTIVE TO HOLD A PUBLIC MEETING BEFORE A SPECIFIC REMEDIAL ACTION PLAN COULD BE DISCUSSED. BECAUSE OF THE INCREASED LEVEL OF PUBLIC INTEREST EXPRESSED DURING THE PUBLIC MEETING, THE AGENCY WILL SCHEDULE ADDITIONAL MEETINGS DURING THE REMEDIAL DESIGN AND REMEDIAL ACTION PROCESS.

COMMENT #2: TWO RESIDENTS EXPRESSED CONCERN BECAUSE THEY WERE NOT AWARE OF THE PROGRAM UNDER WHICH THE PUBLIC COULD OBTAIN TECHNICAL ASSISTANCE GRANTS. THEY ASKED FOR AN EXPLANATION OF THE PROGRAM.

EPA RESPONSE: THE TECHNICAL ASSISTANCE GRANT PROGRAM PROVIDES GRANTS OF UP TO $50,000 TO CITIZENS' GROUPS TO OBTAIN ASSISTANCE IN INTERPRETING INFORMATION RELATED TO CLEANUPS AT SITES ON, OR PROPOSED FOR, THE NPL. THESE GRANTS ARE TO BE USED BY CITIZENS GROUPS TO HIRE TECHNICAL ADVISORS TO HELP THEM UNDERSTAND SITE-RELATED TECHNICAL INFORMATION FOR THE DURATION OF SITE RESPONSE ACTIVITIES.

AN APPLICANT IS ELIGIBLE TO RECEIVE A TECHNICAL ASSISTANCE GRANT IF THAT APPLICANT IS A GROUP OF INDIVIDUALS THAT MAY BE AFFECTED BY A RELEASE OR THREATENED RELEASE OF A HAZARDOUS SUBSTANCE AT A SUPERFUND SITE. THE APPLICANT IS INELIGIBLE IF IT IS A POTENTIALLY RESPONSIBLE PARTY, OR REPRESENTS A GOVERNMENTAL OFFICE OF ANY KIND OR AN ACADEMIC INSTITUTION. THE FOLLOWING ARE EXAMPLES OF ACTIVITIES SUITABLE OR TECHNICAL ADVISORS: (1) REVIEWING AND INTERPRETING SITE-RELATED DOCUMENTS, WHETHER PRODUCED BY EPA OR OTHERS, (2) MEETING WITH THE RECIPIENT GROUP TO EXPLAIN TECHNICAL INFORMATION, (3) PROVIDING ASSISTANCE TO THE RECIPIENT GROUP IN COMMUNICATING THE GROUP'S SITE-RELATED CONCERNS, AND (4) TRAVELING TO MEETINGS, HEARINGS, ETC., DIRECTLY RELATED TO THE SITUATION AT THE SITE.

COST/FUNDING ISSUES

COMMENT #1: TWO RESIDENTS INQUIRED ABOUT THE COST OF THE SELECTED REMEDIAL ACTION. THE RESIDENTS WANTED TO KNOW WHERE THE $882,813 WILL COME FROM, A BREAKDOWN OF HOW IT WILL BE SPENT AND THE PERCENTAGE OF ADMINISTRATIVE COSTS ON THE TOTAL $882,813. ONE RESIDENT ALSO ASKED IF THE MONEY FOR WAGES WILL BE SPENT PRIMARILY FOR EPA STAFF OR FOR LOCAL WORKERS. ONE RESIDENT SUGGESTED AT IT WOULD BE COST-EFFECTIVE TO HAVE EPA INSPECTORS ON SITE DURING THE ENTIRE TIME OF REMEDIATION TO ASSURE THAT THE WORK IS DONE CORRECTLY AND WILL NOT HAVE TO BE REPEATED.

EPA RESPONSE: THE BREAKDOWN OF ESTIMATED COSTS FOR ALTERNATIVE 4A IS AS FOLLOWS:

CAPITAL COSTS

DELINEATION OF FLOODPLAIN AND EXTENT OF CONTAMINATION	175,000
PRE-IMPLEMENTATION SAMPLING OF TWELVE EXISTING AND FIFTEEN FUTURE RESIDENTIAL PROPERTIES	199,000
SOIL COVERING, REMOVAL AND CONFIRMATION SAMPLING OF RESIDENTIAL OF RESIDENTIAL PROPERTIES	604,000
LABOR RELATED TO COUNTY ASSISTANCE IN DEVELOPING LAND USE ORDINANCES	30,000
EDUCATION PROGRAM (INCLUDES DESIGN AND PRINTING OF BROCHURES AND NOTIFICATION OF BUYERS OF SITE PROPERTIES)	20,000
ESTIMATION FOR REMEDIATION OF FUTURE RESIDENTIAL PROPERTIES	447,000

OPERATION AND MAINTENANCE COSTS (ANNUAL)

RE-SAMPLE EXISTING RESIDENTIAL PROPERTIES IN THE FIFTH YEAR AFTER COVERING AND/OR REMOVING SOIL THESE AT PROPERTIES ($26,000 DISTRIBUTED OVER FIVE YEARS)	5,000
MAINTENANCE OF THE EDUCATION PROGRAM	2,000

ANNUAL MONITORING OF WHITEWOOD CREEK 5,000

THE TOTAL CAPITAL COST IS ESTIMATED TO BE $1,028,000. ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS ARE ESTIMATED TO BE $12,000 PER YEAR IN THE FIRST FIVE YEARS AND $6,000 PER YEAR IN THE REMAINING 25 YEARS.

THE NET PRESENT VALUE CALCULATED USING A DISCOUNT RATE OF 5 PERCENT OVER THE 30 YEAR O&M PERIOD IS $882,813.

IF HOMESTAKE OR ANOTHER POTENTIALLY RESPONSIBLE PARTY PERFORMS THE WORK, EPA COSTS WILL BE ASSOCIATED WITH OVERSEEING THE WORK PERFORMED BY THE POTENTIALLY RESPONSIBLE PARTY. IF THE WORK IS UNPLEMENTED ACCORDING TO THE SPECIFICATIONS OF EPA'S ROD AND THE REDIAL DESIGN PLANS WITHOUT ANY SIGNIFICANT PROBLEMS, EPA'S COSTS ARE MINIMIZED. IF THE WORK IS DONE IMPROPERLY, EPA'S OVERSIGHT COSTS CAN ESCALATE SIGNIFICANTLY. USUALLY, EPA'S OVERSIGHT IS SUBSTANTIAL DURING INITIAL REMEDIAL ACTION ACTIVITIES. ONCE EPA IS SATISFIED THAT THE WORK IS BEING CONDUCTED PROPERLY, THE LEVEL OF OVERSIGHT MAY DECREASE TO PERIODIC VISITS. THE POTENTIALLY RESPONSIBLE PARTY WOULD BE RESPONSIBLE OR REIMBURSEMENT OF EPA'S OVERSIGHT COSTS.

UPON ISSUANCE OF THE ROD FOR THE WHITEWOOD CREEK SITE, EPA WILL ISSUE TO HOMESTAKE OR ANY OTHER POTENTIALLY RESPONSIBLE PARTY A SPECIAL NOTICE LETTER OFFERING AN OPPORTUNITY TO CONDUCT THE REMEDIAL ACTION OUTLINED IN EPA'S ROD. IF HOMESTAKE OR ANY OTHER POTENTIALLY RESPONSIBLE PARTY REFUSES TO CONDUCT THIS WORK, EPA WOULD EITHER ORDER ONE OR MORE POTENTIALLY RESPONSIBLE PARTY(IES) TO CONDUCT THE WORK OR MAY OPT TO CONDUCT THE WORK ITSELF. EPA WOULD THEN ATTEMPT TO RECOVER FROM THE POTENTIALLY RESPONSIBLE PARTY, ANY COSTS INCURRED WHILE CONDUCTING THIS WORK.

COMMENT #2: ONE RESIDENT ASKED ABOUT THE COST TO THE COUNTY GOVERNMENT TO IMPLEMENT ORDINANCES.

EPA RESPONSE: EPA DISAGREES WITH CERTAIN ASSUMPTIONS MADE BY HOMESTAKE IN THE FEASIBILITY STUDY, ONE OF WHICH IS THE ASSUMPTION THAT CERTAIN COSTS WOULD BE BORNE BY THE LOCAL COUNTIES. BECAUSE OF THE COST BURDEN TO THE COUNTIES, EPA DOES NOT FEEL THAT THIS ASSUMPTION IS PROPER AND ENCOURAGED SPECIFIC INPUT FROM BUTTE, MEADE AND LAWRENCE COUNTIES ON THEIR ABILITIES TO CONTRIBUTE TO REMEDIAL COSTS. EPA EXPECTS ANY COST INCURRED BY THE COUNTIES TO BE FUNDED BY THE POTENTIALLY RESPONSIBLE PARTY(IES) FOR THE SITE.

DECISION PROCESS

COMMENT #1: ONE RESIDENT QUESTIONED THE PROCEDURE TO BE TAKEN IF THE COUNTIES DO NOT AGREE WITH THE RECOMMENDATIONS OF THE ROD TO IMPLEMENT ORDINANCES.

EPA RESPONSE: AT THE PUBLIC MEETING, EPA REQUESTED FORMAL RESPONSES FROM THE COUNTIES ABOUT THEIR WILLINGNESS TO IMPLEMENT SPECIFIC ORDINANCES. EPA ALSO STATED AT THAT TIME THAT IF THE COUNTIES DID NOT WISH TO COOPERATE, THAT EPA MIGHT CHOOSE ANOTHER ALTERNATIVE. DURING THE PUBLIC COMMENT PERIOD, EPA RECEIVED FORMAL RESPONSES FROM BUTTE, MEADE AND LAWRENCE COUNTIES. EACH COUNTY HAS EXPRESSED A WILLINGNESS TO ENACT ORDINANCES DESCRIBED IN ALTERNATIVE 4A.

TECHNICAL QUESTIONS/CONCERNS REGARDING REMEDIAL ALTERNATIVES

COMMENT #1: ONE RESIDENT ASKED WHERE THE TAILINGS WILL BE TAKEN, IF THEY ARE REMOVED.

EPA RESPONSE: UNDER THE PREFERRED ALTERNATIVE, THE TAILINGS PILES WILL NOT BE REMOVED. ARSENIC-CONTAMINATED SOILS REMOVED ONLY MOM RESIDENTIAL AREAS WOULD BE DISPOSED OF AT A DISPOSAL FACILITY OR LOCATION APPROVED BY EPA AND THE STATE, SUCH AS THE GRIZZLY GULCH TAILINGS IMPOUNDMENT IN LEAD.

COMMENT #2: TWO RESIDENTS QUESTIONED HOW EPA WILL DELINEATE THE WHITEWOOD CREEK FLOODPLAIN AND WHY THERE ISN'T ALREADY A FLOODPLAIN MAP UPON WHICH THE RESIDENTS MAY COMMENT.

EPA RESPONSE: CURRENT DELINEATION OF THE 100-YEAR FLOODPLAIN IS BASED ON FEDERAL EMERGENCY MANAGEMENT AUTHORITY (FEMA) MAPS. THE SCALE OF THESE MAPS IS ONE INCH TO 2,000 FEET. SINCE THIS SCALE IS NOT SUFFICIENT FOR REMEDIAL DESIGN, THIS INFORMATION WILL BE AUGMENTED BY ADDITIONAL SURVEYS TO DELINEATE THE 100-YEAR FLOODPLAIN DURING THE REMEDIAL DESIGN PHASE.

COMMENT #3: ONE RESIDENT ASKED HOW MUCH SOIL COVER WOULD BE PUT OVER RESIDENTIAL SOILS. A SECOND CONCERN EXPRESSED WAS THE EFFECT THAT VARIOUS KINDS OF PLANTS GROWING ON THE CLEAN SOIL WILL HAVE IN TRANSPORTING ARSENIC FROM THE LOWER CONTAMINATED AREA TO THE CLEAN SURFACE.

EPA RESPONSE: THE PARCEL AROUND EACH RESIDENCE WILL BE BASED ON THE MOST ACTIVELY USED PORTION OF THE PROPERTY. FOR PURPOSES OF THE FEASIBILITY STUDY, EPA ESTIMATED THAT A RESIDENTIAL PROPERTY CONSISTS OF A AN EIGHT ACRE AREA WITH UP TO TWO ACRES FOR VEGETABLE GARDENS. EPA IS PROPOSING TO COVER NON-GARDEN AREAS WITH 12 INCHES OF NON-CONTAMINATED SOIL, OR TO REMOVE SOIL TO A DEPTH OF 12 INCHES AND REPLACE WITH ONE FOOT OF CLEAN COVER AS NECESSARY TO MAINTAIN THE LOCAL TOPOGRAPHY. GARDEN AREAS WOULD BE EXCAVATED TO TWO FEET AND BACKFIELD WITH CLEAN SOILS. DRIVEWAY AREAS WOULD BE REPLENISHED WITH SIX INCHES OF GRAVEL.

THESE DEPTHS HAVE BEEN DETERMINED TO BE SUFFICIENT TO ELIMINATE INGESTION OF CONTAMINATION BY SITE RESIDENTS DURING INVASIVE ACTIVITIES (GARDENING, ETC.) AND TO ELIMINATE UPTAKE OF ARSENIC IN THE VEGETATION.

COMMENT #4: ONE RESIDENT WAS CONCERNED ABOUT THE EMPHASIS ON ARSENIC, WHEN OTHER CONTAMINANTS, SUCH AS CYANIDE AND MERCURY, ARE ALSO PRESENT.

EPA RESPONSE: AS PART OF EPA'S FINAL ENDANGERMENT ASSESSMENT, EPA ASSESSED THE POTENTIAL RISK FROM INORGANIC CONTAMINANT CONSTITUENTS ASSOCIATED WITH THE TAILINGS, INCLUDING CYANIDE AND MERCURY. EACH POTENTIAL CONTAMINANT WAS CONSIDERED WITH ITS APPROPRIATE PATHWAY. ALTER THIS EVALUATION, ARSENIC REMAINED THE ONLY CONSTITUENT OF CONCERN. THE OTHER CONTAMINANTS WERE NOT PRESENT IN SUFFICIENT CONCENTRATION TO POSE A SUBSTANTIAL PUBLIC HEALTH RISK.

COMMENT #5: TWO RESIDENTS WERE CONCERNED ABOUT THE POTENTIAL FOR RE-CONTAMINATION OF REMEDIATED AREAS BY FLOODING.

EPA RESPONSE: IF FLOODING OCCURS, THEN THE FLOODED AREA WILL NEED TO BE RESAMPLED. IF THE CONCENTRATIONS EXCEED THE 100 MG/KG ACTION LEVEL, THEN ADDITIONAL REMEDIAL ACTION WILL BE NECESSARY. THE ROD CONTAINS A PROVISION FOR POST-FLOOD SAMPLING AND, IF NECESSARY, RECLAMATION OF PROPERTY.

COMMENT #6: TWO RESIDENTS QUESTIONED THE SIZE OF THE STUDY AREA.

EPA RESPONSE: THE FS STUDY AREA ENCOMPASSES LAND WITHIN THE WHITEWOOD CREEK 100-YEAR FLOODPLAIN BOUNDED TO THE SOUTH BY 1-90 AND TO THE NORTH BY THE BELLE FOURCHE RIVER CONFLUENCE. THE FS STUDY AREA DOES NOT CORRESPOND WITH SITE BOUNDARIES. EPA HAS DEFINED THE BOUNDARIES OF THE WHITEWOOD CREEK SUPERFUND SITE AS THE AREA WITHIN THE 100-YEAR FLOODPLAIN. THE SOUTHERN BOUNDARY OF THE SITE IS THE CROOK CITY BRIDGE. THE NORTHERN BOUNDARY OF THE SITE IS AT THE WHITEWOOD CREEK AND BELLE FOURCHE RIVER CONFLUENCE.

COMMENT #7: TWO RESIDENTS ASKED FOR CLARIFICATION ON WHAT EPA CONSIDERED TO BE A RESIDENTIAL PROPERTY. ONE RESIDENT SAID THAT SOIL SAMPLE SURVEYS SHOWED GREATER THAN 600 MG/KG ARSENIC WITHIN 200 FEET OF THE HOUSE AND REQUESTED TO KNOW THE AREA REQUIRING REMEDIATION.

EPA RESPONSE: A RESIDENTIAL PROPERTY IS DEFINED AS THE AREA USED FOR A RESIDENCE OR DOMICILE. THE PARCEL AROUND EACH OF THE RESIDENCES WILL BE BASED ON THE MOST ACTIVELY USED PORTION OF THE PROPERTY INCLUDING THE IMMEDIATE YARD (NON GARDEN) AROUND THE RESIDENCE, AND THE DRIVEWAY AND GARDEN AREAS. EPA HAS ESTIMATED THAT THE SIZE OF A RESIDENTIAL PROPERTY WITHIN THE SITE IS UP TO EIGHT ACRES. REMEDIATION WILL BE CONDUCTED IN COORDINATION WITH PROPERTY OWNERS ON ONLY THOSE SOILS EXHIBITING ARSENIC CONCENTRATION OF GREATER THAN 100 MG/KG.

COMMENT #8: ONE RESIDENT SAID HE HAS NOTICED A REDUCTION IN WILDLIFE, SUCH AS BIRDS AND RABBITS, IN AREAS OF CONTAMINATION. HE QUESTIONED THE EFFECT ON WILDLIFE FROM REMEDIAL ACTION.

EPA RESPONSE: EPA IS NOT AWARE OF A REDUCTION OF WILDLIFE IN THE STUDY AREA. EPA IS CONCERNED, HOWEVER, THAT REMOVAL OF THE TAILINGS WILL RESULT IN AN ADVERSE SHORT-TERM IMPACT ON THE ECOLOGICAL HABITAT ALONG WHITEWOOD CREEK. IN ADDITION THERE IS A POTENTIAL OF RELEASE OF TAILINGS MATERIAL INTO WHITEWOOD CREEK AS A RESULT OF REMOVAL OF THE TAILINGS. THE SELECTED REMEDY WILL NOT ADVERSELY AFFECT THE ECOLOGICAL HABITAT OF THE WHITEWOOD CREEK AREA IN THE SHORT TERM.

COMMENT #9: TWO RESIDENTS ASKED FOR CLARIFICATION ON THE POTENTIAL FOR EXCAVATION (MINING) OF THE TAILINGS. THE QUESTIONS DEAL WITH WHO WOULD HAVE JURISDICTION OVER THE MINING ACTIVITY, AND WHAT KIND OF MINING RESTRICTIONS ARE THERE TO PREVENT CONTAMINATION FROM FUTURE MINING ACTIVITIES.

EPA RESPONSE: UNDER THE SUPERFUND PROGRAM, EPA IS CHARGED BY CONGRESS WITH PROTECTING THE PUBLIC HEALTH AND THE ENVIRONMENT. THE OBJECTIVE OF EPA'S SELECTED REMEDY IS TO REDUCE THE EXPOSURE OF ARSENIC IN THE DOWNGRADIENT GROUNDWATER, RESIDENTIAL SOILS, AND TAILINGS TO ACCEPTABLE RISK LEVELS. MINING OF WHITEWOOD CREEK IS CONSIDERED TO BE AN ECONOMIC VENTURE WHICH WILL BE PERMITTED AND REGULATED UNDER THE JURISDICTION OF THE STATE OF SOUTH DAKOTA MINING REGULATIONS. ANY MINING ACTIVITIES AND THEIR EFFECTS ON PUBLIC HEALTH AND THE ENVIRONMENT WOULD BE CLOSELY MONITORED BY THE STATE OF SOUTH DAKOTA AND ANY ADVERSE EFFECTS WOULD BE EVALUATED BY EPA IN ITS 5-YEAR REVIEW OF THE SUPERFUND SITE TO ENSURE PROTECTIVENESS OF HUMAN HEALTH AND THE ENVIRONMENT.

COMMENT #10: SEVERAL QUESTIONS WERE RAISED ABOUT THE RISK ASSESSMENT. ONE RESIDENT WAS CONFUSED ABOUT THE REAL POTENTIAL FOR CANCER DEVELOPMENT, SINCE APPARENTLY THE LOCAL POPULATION IS GENERALLY HEALTHY AND THE CREEK IS RECLAIMING ITSELF. HOMESTAKE EXPRESSED ITS CONCERN THAT THE COST OF REMEDIAL ACTION MAY NOT BE JUSTIFIED, BASED ON RISK POTENTIAL. ANOTHER RESIDENT WAS CONFUSED ABOUT HOW THE NEED TO COVER THE OILS AROUND RESIDENTIAL AREAS WAS RELATED TO REDUCING THE CANCER RISK TO ONE OUT OF 10,000.

EPA RESPONSE: EPA HAS DETERMINED THAT UNACCEPTABLE PUBLIC HEALTH RISK IS POSED THROUGH INCIDENTAL LIFETIME INGESTION OF RESIDENTIAL SOILS WITH ARSENIC CONCENTRATION EXCEEDING 100 MG/KG. THE 100 MG/KG ACTION LEVEL IS A LEVEL THAT CORRESPONDS TO REDUCING THE HEALTH RISK AT THE SITE FROM THE INGESTION OF ARSENIC TO AN ACCEPTABLE LEVEL. THIS RISK LEVEL CORRESPONDS TO THE CHANCE OF ONE ADDITIONAL PERSON OUT OF 10,000 CONTRACTING CANCER AS RESULT OF SITE CONDITIONS. EPA'S SELECTED REMEDY ENTAILS COVERING CONTAMINATED SOILS WITH CLEAN SOILS SO THAT THE RISK FROM SOIL INGESTION IS REDUCED TO AN ACCEPTABLE LEVEL.

COMMENT #11: SEVERAL QUESTIONS INVOLVED THE USE OF INSTITUTIONAL CONTROLS. MANY OF THE RESIDENTS DID NOT THINK IT WOULD BE POSSIBLE TO KEEP SIGNS UP FOR ANY LENGTH OF TIME. ONE RESIDENT WAS AGAINST DEED RESTRICTIONS AND WARNING SIGNS BECAUSE OF THE POTENTIAL NEGATIVE EFFECT ON LAND VALUES.

EPA RESPONSE: THE PURPOSE OF WARNING SIGNS PROPOSED AS PART OF THE PREFERRED REMEDY WAS TO DISCOURAGE EXTENDED AND FREQUENT ACTIVITY WITHIN THE TAILINGS AREA. AS A RESULT OF EXPRESSED COMMUNITY CONCERN REGARDING THE POSTING OF WARNING SIGNS IN THE TAILINGS AREA AND THE REALITY THAT THEY WOULD LIKELY NOT HAVE MUCH EFFECT SINCE THE OCCASIONAL RECREATION USER IS NOT AT UNACCEPTABLE RISK ACCORDING TO EPA'S ENDANGERMENT ASSESSMENT, EPA HAS DECIDED NOT TO INCORPORATE THIS ELEMENT AS PART OF ITS SELECTED REMEDY.

EPA HAS ALSO NOT INCORPORATED DEED RESTRICTIONS AS PART OF THE SELECTED SITE REMEDY AS STATED IN THE ROD DUE TO COMMUNITY OPPOSITION. EPA REQUIRES, HOWEVER, THAT AS PART OF THE EDUCATIONAL PROGRAM, PROSPECTIVE BUYERS OF PROPERTY WITHIN THE SITE BE INFORMED OF POTENTIAL HAZARDS ASSOCIATED WITH THE SITE.

COMMENT #12: THE ISSUE OF FUTURE DEVELOPMENT WAS DISCUSSED. ONE RESIDENT DID NOT FEEL THAT FUTURE DEVELOPMENT IN THE FLOODPLAIN WAS DESIRABLE AND THAT THERE WAS PROBABLY AN ORDINANCE COVERING THIS. ANOTHER RESIDENT QUESTIONED WHAT DEVELOPMENT WOULD BE ALLOWED OR DISALLOWED.

EPA RESPONSE: ALTHOUGH EPA DOES NOT BELIEVE IT IS WISE TO DEVELOP WITHIN THE WHITEWOOD CREEK 100-YEAR FLOODPLAIN AND EPA DISCOURAGES SUCH ACTIVITIES, THE SELECTED REMEDY ALLOWS FOR SUCH DEVELOPMENT IF THE APPROPRIATE CLEANUP ACTIONS ARE TAKEN. DEVELOPMENT RESTRICTIONS WITHIN THE SITE ARE CURRENTLY IN PLACE FOR LAWRENCE COUNTY. THE EPA-SELECTED REMEDY ENTAILS THE IMPLEMENTATION OF ADDITIONAL RESTRICTIONS WITHIN THE SITE FOR LAWRENCE, BUTTE AND MEADE COUNTIES. EPA HAS MET WITH THE COMMISSIONERS OF LAWRENCE, BUTTE AND MEADE COUNTIES TO ASSESS THE WILLINGNESS OF THE COUNTIES TO SUPPORT LAND USE ORDINANCES TO RESTRICT DEVELOPMENT. EACH OF THESE COUNTIES EXPRESSED A WILLINGNESS TO COOPERATE.

B. SUMMARY OF WRITTEN PUBLIC COMMENTS

LETTERS RECEIVED FROM THE PUBLIC INDICATED CONCERN ABOUT THE EFFECT DEED RESTRICTIONS AND WARNING SIGNS WOULD HAVE ON PROPERTY VALUES. STATEMENTS WERE MADE BOTH IN SUPPORT OF EPA'S RISK ASSESSMENT AND IN QUESTION OF ITS VALIDITY. ONE OF THE MAJOR CONCERNS WAS THAT DEVELOPMENT VARIANCES BE ALLOWED SO THAT A WATER TREATMENT SYSTEM FOR THE CITY OF WHITEWOOD CAN BE INSTALLED.

COST/FUNDING ISSUES

COMMENT #1: A RESIDENT EXPRESSED CONCERN THAT MANY OF THE STUDIES TO DATE, INCLUDING THE FEASIBILITY STUDY, WERE PAID FOR BY HOMESTAKE AND DONE BY THEIR CONSULTANTS. WHILE HE UNDERSTANDS THAT FUNDING IS A PROBLEM FOR EPA, THE RESIDENT WOULD "FEEL MUCH BETTER AND HAVE MUCH MORE FAITH IN THE PROJECT" IF EPA HAD CONDUCTED THE STUDIES AND RECOVERED THE EXPENSES FROM THE RESPONSIBLE PARTIES.

EPA RESPONSE: AT THE PUBLIC MEETING ON JANUARY 25,1990, MR.LEVENE OF EPA STATED THAT HOMESTAKE WOULD BE REQUIRED TO MONITOR SITE CONDITIONS FOR 5 YEARS. FOR SUPERFUND CLEANUPS AND INVESTIGATIONS, EPA IS REQUIRED BY CONGRESS TO OFFER THE POTENTIALLY RESPONSIBLE PARTIES THE OPPORTUNITY TO CONDUCT THE PROPOSED WORK. IT IS THE INTENT OF CONGRESS THAT THOSE PARTIES WHO ARE RESPONSIBLE FOR THE CONTAMINATION SHOULD BE OBLIGATED TO CLEAN UP THE CONTAMINATION. THIS WORK IS CONDUCTED UNDER THE EXTENSIVE OVERSIGHT OF EPA. IF A POTENTIALLY RESPONSIBLE PARTY REFUSES TO IMPLEMENT SELECTED REMEDIES OUTLINED IN THE WOULD EITHER ORDER THE POTENTIALLY RESPONSIBLE PARTY TO CONDUCT THE WORK OR OPT TO IMPLEMENT THE SELECTED REMEDY ITSELF. EPA WOULD THEN ATTEMPT TO RECOVER FROM THE POTENTIALLY RESPONSIBLE PARTY ANY COST INCURRED.

TECHNICAL QUESTIONS CONCERNING REMEDIAL ALTERNATIVES

COMMENT #1: SEVERAL RESIDENTS EXPRESSED CONCERN ABOUT THE NEED FOR POSTING SIGNS AND ERECTING FENCES ON THEIR PROPERTY WHEN EPA AND HOMESTAKE SAY THAT IT IS SAFE FOR RESIDENTS TO LIVE THERE AND CARRY ON NORMAL ACTIVITIES AND FOR SPORTSMEN TO VISIT. FENCING THEIR WINTER PASTURE, WHICH IS ALONG WHITEWOOD CREEK, WOULD CREATE A PROBLEM OF ACCESS TO WATER AND SHELTER; THIS ACCESS HAS BEEN USED FOR THE PAST 50 YEARS. OTHER CONCERNS WERE THAT SIGNS WOULD BE INEFFECTIVE AND NOT WORTH THE COST OF ADMINISTERING AND THAT THIS PROGRAM WOULD BE AN EXTRA BURDEN ON THE LOCAL COUNTY GOVERNMENTS, WHICH ARE ALREADY FINANCIALLY STRAPPED.

EPA RESPONSE: IN RESPONSE TO CONCERNS OF PRIVATE CITIZENS AND HOMESTAKE, EPA AGREES THAT THE POSSIBLE BENEFITS OF SIGNS AND FENCES WOULD BE OUTWEIGHED BY DISADVANTAGES. SIGNS AND FENCES HAVE NOT BEEN INCLUDED IN THE SELECTED REMEDY.

COMMENT #2: THREE RESIDENTS WROTE ON THE SUBJECT OF DEED RESTRICTIONS. THE MAJOR CONCERN IS THAT IF THE SITE IS COMPLETELY CLEANED UP, THEN DEED RESTRICTIONS ARE UNNECESSARY. IF CONTAMINATION IS LEFT AND DEED RESTRICTIONS ARE PLACED ON THEIR PROPERTY, THEN THE RESTRICTIONS MAY AFFECT THE PROPERTY VALUE. ANY REMEDIAL PROGRAM SHOULD INCREASE THE LAND'S VALUE, NOT DECREASE IT.

EPA RESPONSE: IN RESPONSE TO THIS CONCERN, EPA HAS NOT INCORPORATED DEED RESTRICTION AS PART OF ITS SELECTED REMEDY. EPA REQUIRES, HOWEVER, THAT PROSPECTIVE BUYERS OF PROPERTY WITHIN THE SITE BE INFORMED OF POTENTIAL HAZARDS AS PART OF THE EDUCATIONAL PROGRAM FOR THE SITE.

COMMENT #3: SEVERAL PARTIES ADDRESSED THE ISSUE OF DEVELOPMENT RESTRICTIONS FROM DIFFERENT VIEW POINTS. THERE WAS CONCURRENCE THAT RESIDENTIAL BUILDING SHOULD BE PROHIBITED ON THE TAILINGS AREAS. IT WAS STATED THAT BECAUSE EVERY RANCH ALONG WHITEWOOD CREEK IS DEPENDENT UPON SOME KIND OF LIVESTOCK OPERATION FOR ITS SUCCESS, ANY DEVELOPMENT RESTRICTIONS THAT WOULD HAVE A NEGATIVE IMPACT ON THE LIVESTOCK INDUSTRY WOULD BE OBJECTIONABLE.

EPA RESPONSE: EPA'S REMEDY DOES NOT RESTRICT GRAZING OF CATTLE ON THE TAILINGS AREA. COMMERCIAL (E.G., FEEDLOT, INDUSTRIAL PROPERTY) AND RESIDENTIAL DEVELOPMENT, HOWEVER, WILL NOT BE ALLOWED IN THE TAILINGS AREA. COMMERCIAL DEVELOPMENT WILL BE ALLOWED WITHIN THE 100-YEAR FLOODPLAIN BUT OUTSIDE THE TAILINGS AREA IF APPROPRIATE ACTIONS ARE TAKEN. EPA WILL ALLOW A VARIANCE FOR PUBLIC WORKS PROJECTS WITHIN THE 100-YEAR FLOODPLAIN AND TAILINGS AREA.

COMMENT #4: MEADE AND LAWRENCE COUNTY OFFICIALS EXPRESSED WILLINGNESS TO COOPERATE WITH THE EPA IN MATTERS OF PUBLIC HEALTH. THE COUNTIES WILL CONSULT WITH THE STATE CONCERNING THE PROPOSED ORDINANCES. THEY REQUEST A FORMAL LETTER FROM EPA DEFINING SPECIFIC HEALTH HAZARDS, INCLUDING SPECIFIC MAPS OF THE AFFECTED AREAS AND DESIRED COUNTY ACTIONS.

EPA RESPONSE: EPA HAS DOCUMENTED THE PRESENCE OF A PUBLIC HEALTH RISK IN THE EPA FINAL ENDANGERMENT ASSESSMENT.

COMMENT #5: OFFICIALS OF THE STATE AND THE CITY OF WHITEWOOD, AS WELL AS SITE RESIDENTS, REQUESTED THAT A PUBLIC WORKS VARIANCE BE ALLOWED. SPECIFICALLY, A VARIANCE IS REQUESTED FOR THE PROPOSED LAGOON AND ARTIFICIAL WETLANDS TO BE BUILT NORTH OF THE WHITEWOOD ALLEY ROAD ON HOMESTAKE PROPERTY.

EPA RESPONSE: EPA DOES NOT SEE A HEALTH THREAT FROM THIS PROPOSED ACTION AND THEREFORE WOULD NOT OBJECT TO THIS PROPOSAL.

COMMENT #6: SEVERAL CITIZENS THINK THAT THE ESTIMATE OF ENDANGERMENT TO HUMAN HEALTH IS UNREALISTIC. ONE WOMAN WROTE THAT BETWEEN 1951 AND 1971, SHE AND HER LATE HUSBAND OWNED LAND IN BUTTE COUNTY WHERE WHITEWOOD CREEK RUNS INTO THE BELLE FOURCHE RIVER. THEY HAD A HERD OF COWS AND CALVES THERE FOR 20 YEARS AND DID NOT OBSERVE ANY ILL EFFECTS FROM THE CYANIDE IN THE WATER. NOW THAT IT HAS ALL BEEN CLEANED UP, SHE WONDERS WHY EPA IS ASKING FOR FURTHER CLEAN-UP.

EPA RESPONSE: DUE TO ARSENIC CONTAMINATION IN THE RESIDENTIAL SOILS, TAILINGS AND GROUNDWATER WHICH STILL REMAINS DESPITE OTHER CLEAN-UP EFFORTS, EPA HAS DETERMINED THAT FURTHER ACTION IS REQUIRED AT THE SITE TO PROTECT THE PUBLIC HEALTH OF SITE RESIDENTS.

COMMENT #7: ONE RESIDENT BELIEVES THAT EPA IS TAKING THE WRONG APPROACH TO REMEDY THE CONCERN ABOUT RESIDENCES LOCATED ON HIGHLY CONTAMINATED SOILS. THIS RESIDENT ESTIMATED, USING EPA'S COST PROJECTIONS, THAT IT WOULD COST APPROXIMATELY $65,000 PER RESIDENCE TO EXCAVATE AND REFILL WITH NEW SOIL. THE RECOMMENDED THE EPA SHOULD CONSIDER MOVING THE "RESIDENCES" TO AN UNCONTAMINATED AREA AND ELIMINATING THE HAZARD ENTIRELY WHICH HE BELIEVED MAY BE A MORE ECONOMICAL AND SATISFACTORY SOLUTION.

EPA RESPONSE: BECAUSE THERE IS NO ACUTE PUBLIC HEALTH THREAT TO THE SITE RESIDENTS THAT CANNOT BE REMEDIATED WITHOUT MOVING RESIDENTS, EPA HAS DETERMINED THAT RELOCATION OF THE RESIDENTS IS UNWARRANTED.

COMMENT #8: ONE CONCERNED CITIZEN ADVOCATED THE IMPLEMENTATION OF ALTERNATIVE 9. HIS ARGUMENT WAS THAT OVER THE LAST 100 YEARS OF HOMESTAKE'S INVOLVEMENT IN THE STATE OF SOUTH DAKOTA, HOMESTAKE HAS REAPED PROFITS FAR IN EXCESS OF THE $109 MILLION DOLLAR COST ESTIMATED IN THE PROPOSED PLAN FOR ALTERNATIVE 9. HE FELT THAT HOMESTAKE'S PROFITS WERE AT THE EXPENSE OF THE ENVIRONMENT, SINCE EPA HAS IDENTIFIED HOMESTAKE AS THE POTENTIALLY RESPONSIBLE PARTY. HE QUESTIONED WHY EPA PREFERRED ALTERNATIVE 4A, BECAUSE IF COST WAS NOT A FACTOR (AND SHOULD NOT BE), THEN THE BENEFITS OF ALTERNATIVE 9 WERE BETTER THAN THOSE OF ALTERNATIVE 4A.

THIS CITIZEN POINTED OUT THAT SOUTH DAKOTA'S GOVERNOR ADVOCATES ECONOMIC DEVELOPMENT AS THE KEY TO THE STATE'S FUTURE. IMPLEMENTING ALTERNATIVE 9 WOULD PUT MORE MONEY BACK INTO THE STATE'S ECONOMY AND WOULD MORE THOROUGHLY CLEAN UP WHITEWOOD CREEK AT THE SAME TIME. IN SHORT, THIS CITIZEN BELIEVED THAT THE BENEFITS OF ALTERNATIVE 9 JUSTIFY ITS SELECTION OVER ALTERNATIVE 4A, EVEN CONSIDERING THE HIGHER COST.

EPA RESPONSE: UNDER THE SUPERFUND PROCESS, COST IS ONE OF THE NINE CRITERIA USED TO EVALUATE ALTERNATIVES AND THE SELECTION OF THE PREFERRED AND SELECTED REMEDY. EPA DID NOT SELECT ALTERNATIVE 9 (REMOVAL OF THE TAILINGS) DUE TO THE HIGH COST OF THE ALTERNATIVE AND IMPACTS ON THE WHITEWOOD CREEK ECOSYSTEM. EPA'S SELECTED REMEDY (SIMILAR TO THE PREFERRED ALTERNATIVE) PROVIDES ONLY A SLIGHTLY LESS DEGREE OF PROTECTIVENESS TO PUBLIC HEALTH THAN ALTERNATIVE 9, AT A MUCH LOWER COST.

MINING

COMMENT #1: SEVERAL RESIDENTS WROTE TO ENDORSE THE REMOVAL AND MINING OF TAILINGS ALONG WHITEWOOD CREEK, AS LONG AS IT IS UNDER THE SUPERVISION OF THE STATE OF SOUTH DAKOTA. OTHER CITIZENS WERE CONCERNED ABOUT HOMESTAKE'S PROPOSED PROJECT TO MINE THE TAILINGS. THEY

FEEL THERE IS A LACK OF CONCERN ON THE PART OF THE COMPANY FOR THE LONG-TERM RECLAMATION OF THE LAND. THIS CONCERN, AS EXPRESSED BY ONE PERSON, IS BASED ON MINING COMPANIES' PAST RECORD IN THE
LACK OF LONG-RANGE RECLAMATION PLANNING AND INPUT FROM "OFFICIALS" WITH WHOM HE HAS SPOKEN ON THIS ISSUE. IT WAS FELT THAT MINING COULD BE VIAB1E IF: 1) THERE WERE STRICT REGULATION AND ENFORCEMENT BY FEDERAL AGENCIES (THE STATE AND LOCAL GOVERNMENTS WOULD NOT BE ABLE TO PROVIDE THE SAME STRENGTH AS THE FEDERAL GOVERNMENT); 2) THERE IS ENVIRONMENTAL PROTECTION OF SOIL, WATER AND AIR WHILE THE PROJECT WAS UNDERWAY; AND 3) THERE IS A DEFINITE AND DETAILED PLAN FOR RECLAMATION OF THE LAND (HOMESTAKE SHOULD MAKE A SUFFICIENT PROFIT FROM THE MINING OPERATION TO PAY FOR PLANTING NATIVE SPECIES OF TREES, SHRUBS AND GROUND COVER).

EPA RESPONSE: MINING ACTIVITIES AT THE SITE WILL BE REGULATED UNDER THE JURISDICTION OF THE STATE OF SOUTH DAKOTA MINING REGULATIONS. EPA, AS THE LEAD FEDERAL ENVIRONMENTAL AGENCY ADMINISTERING ENVIRONMENTAL STATUTES, HAS THE AUTHORITY TO STOP MINING OPERATIONS AT THE SITE IF THE PUBLIC HEALTH OR ENVIRONMENTAL IS THREATENED AS A RESULT OF RELATED ACTIVITIES.

C. SUMMARY OF HOMESTAKE COMMENTS ON THE PREFERRED ALTERNATIVE

HOMESTAKE SUBMITTED COMMENTS ON EPA'S PREFERRED ALTERNATIVE ON FEBRUARY 7,1990 DURING THE PUBLIC COMMENT PERIOD. PRIOR TO THIS PUBLIC COMMENT PERIOD, HOMESTAKE SUBMITTED COMMENTS ON EPA'S FINAL ENDANGERMENT ASSESSMENT ON OCTOBER 6,1989. THE ENDANGERMENT ASSESSMENT BEARS DIRECTLY ON EPA'S PREFERRED AND SELECTED REMEDY. MOST OF THESE COMMENTS WERE REITERATED IN THEIR OFFICIAL COMMENTS TO THE PREFERRED ALTERNATIVE SUBMITTED ON FEBRUARY 7,1990. LETTERS OF COMMENT WERE ALSO SUBMITTED BY GARY DIETRICH, ICF TECHNOLOGIES, HOMESTAKE'S CONTRACTOR, ON JANUARY 30,1990 AND FEBRUARY 9,1990.

EPA NOTES AT THE OUTSET THAT HOMESTAKE'S COMMENTS INCLUDED SEVERAL ISSUES ON WHICH HOMESTAKE IS IN AGREEMENT WITH EPA'S PREFERRED REMEDY. THE AREAS OF AGREEMENT INCLUDE:

(1) IMPLEMENTATION OF INSTITUTIONAL CONTROLS TO RESTRICT ACCESS TO AND USE OF THE TAILINGS DEPOSITS AREAS

(2) IMPLEMENTATION OF AN EDUCATIONAL PROGRAM TO EDUCATE SITE RESIDENTS OF RISK POSED BY THE SITE

(3) CONTINUANCE OF THE STATE OF SOUTH DAKOTA BAN ON INSTALLATION OF WATER WELLS WITHIN THE WHITEWOOD CREEK 100-YEAR FLOODPLAIN

(4) INCLUSION OF WAIVER FOR COMPLIANCE WITH MAXIMUM CONCENTRATION LEVELS (MCLLS) IN GROUNDWATER

(5) REGULATION OF MINING WITHIN SITE UNDER THE JURISDICTION OF THE STATE OF SOUTH DAKOTA

THIS DISCUSSION WILL NOT ADDRESS THESE AREAS OF AGREEMENT IN DETAIL, BUT RATHER WILL FOCUS ON AREAS WHERE HOMESTAKE'S POSITION DIFFERS FROM EPA'S POSITION.

HOMESTAKE'S MAIN CONCERN WAS THAT EPA'S PROPOSED PLAN IS BASED UPON EPA'S ENDANGERMENT ASSESSMENT WHICH OVERSTATES THE RISKS AT THE SITE. HOMESTAKE SUPPORTS THIS CONTENTION BY PROVIDING COMMENTS ON (1) THE INGESTION RATE OF SOIL, (2) CANCER POTENCY FACTOR FOR ARSENIC, (3) DETOXIFICATION OF ARSENIC, AND 4) ASSESSMENT OF FUTURE LAND USE. OTHER COMMENTS RELATE TO DETAILS OF THE PREFERRED ALTERNATIVE, ESPECIALLY AS RELATED TO THE ACTION LEVEL. COMMENTS ARE ALSO PROVIDED ON SPECIFIC POINTS WHERE PUBLIC INPUT WAS REQUESTED BY EPA IN THE PROPOSED PLAN.

COMMENT #1: HOMESTAKE STATED THAT THE RELEVANT POPULATION OF CONCERN FOR PURPOSES OF ESTIMATING EXPOSURE INCLUDE ONLY THOSE PEOPLE LIVING IN THE FLOODPLAIN AREA. THEY CONTEND THAT THE ONE-MILE AND THREE-MILE POPULATIONS SHOULD BE EXCLUDED, AS SHOULD THE TOWN OF WHITEWOOD. THEY INDICATE THAT THE PROPOSED PLAN INCORRECTLY STATED THE ONE-AND THREE-MILE POPULATIONS.

HOMESTAKE ALSO STATED THAT THE PAST AND PRESENT USE OF THE TAILINGS DEPOSITS AND FRINGE AREAS FOR NATIVE WOODLANDS AND LIMITED AGRICULTURE ARE UNLIKELY TO CHANGE IN THE FORESEEABLE FUTURE.

EPA RESPONSE: THE ONE-MILE AND THREE-MILE POPULATIONS WERE REPORTED INCORRECTLY IN EPA'S PROPOSED PLAN. THE CORRECT FIGURES, FROM THE FS, ARE 283 AND 647 RESPECTIVELY, WITH AN ADDITIONAL POPULATION OF 821 IN THE TOWN OF WHITEWOOD. THIS ERROR DOES NOT AFFECT EPA'S ASSESSMENT OF RISK AT THE SITE.

EPA IS REQUIRED BY SUPERFUND REGULATIONS TO CONSIDER A REASONABLE MAXIMUM EXPOSURE SCENARIO FOR THE SITE. THIS SCENARIO ASSUMED HABITATION OF THE TAILINGS AREA. ALTHOUGH CURRENTLY NO RESIDENTS HAVE BUILT ON THE TAILINGS, THIS SCENARIO SEEMS VERY PLAUSIBLE, AS REPRESENTED BY THE CLOSE PROXIMITY OF PRESENT HOMES TO THE TAILINGS, AND THE POSSIBILITY OF FUTURE PRESSURE TO INCREASE DEVELOPMENT IN THE AREA. AS A RESULT OF ASSESSING THIS SCENARIO, EPA PROPOSES TO HAVE THE COUNTIES ENACT ORDINANCES TO RESTRICT DEVELOPMENT IN THE TAILINGS AREA. THIS PORTION OF THE REMEDY IS SUPPORTED BY HOMESTAKE.

COMMENT #2: HOMESTAKE STATED THAT BECAUSE OF THE VERY SUBSTANTIAL BUFFERING CAPABILITY WHICH OCCURS NATURALLY BY VIRTUE OF THE PRESENCE OF CARBONATE MATERIAL THROUGH THE SITE, THERE WILL NOT BE SUBSTANTIAL ARSENIC RELEASES FROM THE ARSENOPYRITE AND OTHER ARSENIC MINERALS IN THE TAILINGS.

EPA RESPONSE: EPA AGREES THAT IN RELATION TO SUBSTANTIAL AMOUNT OF ARSENIC IN THE TAILINGS, THE RATE OF RELEASE OF ARSENIC TO THE SURFACE WATER AND GROUNDWATER IS RELATIVELY SLOW. THIS RELEASE IS SIGNIFICANT, HOWEVER, BECAUSE IT IS DOES RESULT IN AN EXCEEDANCE OF EPA'S MAXIMUM CONCENTRATION LEVEL OF ARSENIC FOR DRINKING WATER IN THE GROUNDWATER.

DESPITE THE FACT THAT THERE ARE NO INDICATIONS OF SIGNIFICANT SURFACE WATER QUALITY DEGRADATION OF WHITEWOOD CREEK, EPA REMAINS CONCERNED ABOUT POTENTIAL FOR FUTURE DEGRADATION OF THE SURFACE WATER. THIS CONCERN IS SUPPORTED BY THE ESTIMATION THAT 30,000 TO 35,000 KILOGRAMS OF ARSENIC ARE RELEASED INTO SURFACE WATER DURING HIGH FLOW EVENTS. AS A RESULT OF THIS CONCERN, EPA IS REQUIRING ADDITIONAL SURFACE WATER MONITORING AS PART OF THE SELECTED REMEDY FOR THE SITE.

COMMENT #3: HOMESTAKE STATED THAT THE EXPOSURE ASSESSMENT CONDUCTED BY JOSEPH RODERICKS, ENVIRON CORPORATION, TITLED ASSESSMENT OF EXPOSURE AND POSSIBLE EFFECTS ON HUMAN HEALTH OF GOLD MINE TAILINGS IN THE WHITEWOOD CREEK AREA OF SOUTH DAKOTA, CONSTITUTES A FULLY SATISFACTORY ENDANGERMENT ASSESSMENT.

EPA RESPONSE: THE REMEDIAL ACTION OBJECTIVES FOR THE SITE WERE BASED ON EPA'S FINAL ENDANGERMENT ASSESSMENT. THESE OBJECTIVES WERE BASED ON PATHWAYS SUCH AS INCIDENTAL SOIL INGESTION AND INGESTION OF DOWNGRADIENT ALLUVIAL GROUNDWATER WHICH WERE NOT EXAMINED IN THE ABOVE REFERENCED REPORT. THE PATHWAYS ASSESSED IN EPA'S ENDANGERMENT ASSESSMENT AND THE METHODOLOGY FOR CALCULATING ENDANGERMENT AT THE SITE ARE FULLY CONSISTENT WITH EPA GUIDANCE AND THE NATIONAL CONTINGENCY PLAN.

COMMENT #4: HOMESTAKE COMMENTED THAT "DESPITE OVER A CENTURY OF ENVIRONMENTAL AND HUMAN RESIDENTIAL EXPOSURE TO TAILINGS, IF THE TAILINGS POSED ANY THREAT TO HUMAN HEALTH, SURELY THEIR EFFECTS WOULD BE IN EVIDENCE."

EPA RESPONSE: THE POPULATION ALONG WHITEWOOD CREEK IS NOT OF SUFFICIENT SIZE TO DISPLAY ONGOING CANCER PROBLEMS AS A RESULT OF THE EXPOSURES PREDICTED. THE EPA'S ENDANGERMENT ASSESSMENT PREDICT THAT SUCH PROBLEMS MAY ARISE INTERMITTENTLY AS A RESULT OF EXPOSURE TO THE TAILINGS ALONG WHITEWOOD CREEK. SINCE DATA TO DETERMINE PAST PROBLEMS IS MISSING, IT IS IMPOSSIBLE TO ASSESS HISTORICAL SITE-RELATED HEALTH PROBLEMS.

COMMENT #5: HOMESTAKE DISPUTED SOIL INGESTION RATES USED BE EPA (100 MG/DAY FOR ADULTS, 200 MG/DAY FOR CHILDREN). HOMESTAKE RECOMMENDED THE USE OF LOWER RATES(10 MG/DAY FOR ADULTS, 50 MG/DAY FOR CHILDREN).

EPA RESPONSE: THE SOIL INGESTION RATE ESTIMATES SUGGESTED BY HOMESTAKE RE RESENT CENTRAL TENDENCY CALCULATIONS (MEDIAN) FROM A SINGLE STUDY A(CALABRESE ET AL., 1989). THESE ESTIMATES ARE INACCURATE AND INAPPROPRIATE FOR SEVERAL REASONS:

(A) THE CALABRESE STUDY WAS CONDUCTED ON A NONRANDOM POPULATION.

(B) PARENTS OF CHILDREN USED IN THE STUDY WERE HIGHLY EDUCATED, OF HIGHER THAN AVERAGE INCOME, AND MARRIED. ALL OF THE ABOVE HAVE A STRONG POTENTIAL FOR SKEWING THE STUDY RESULTS TOWARD LOWER INGESTION RATES.

(C) THE STUDY WAS CONDUCTED ON A POPULATION WHICH WAS UNDER CONSTANT DAYCARE SUPERVISION. THIS IS IN CLEAR CONTRAST TO THE AGRICULTURAL SETTING AND BEHAVIOR OF THE POPULATION ALONG "WHITEWOOD CREEK.

(D) SINCE THE DATA REPRESENTED IN THE CALABRESE REPORT ARE LOG NORMALLY DISTRIBUTED, THE BEST MEASURE OF CENTRAL TENDENCY IS THE GEOMETRIC MEAN AND NOT THE MEDIAN. TABULATED BELOW ARE THE GEOMETRIC MEAN, MEDIAN, AND 95 PERCENTILE OF THE CALABRESE DATA:

TRACER	MEAN (MG/D)	MEDIAN (MG/D)	95 PERCENT
AL	153	29	223
SI	154	40	276
Y	85	9	106

AS IS EVIDENT FROM THE DIFFERENCE BETWEEN THE MEDIAN AND GEOMETRIC MEAN VALUES PRESENTED ABOVE, HOMESTAKE IS SUGGESTING A SOIL INGESTION RATE WHICH MAY SERIOUSLY UNDERESTIMATE THE EXPOSURE AT THE WHITEWOOD CREEK SUPERFUND SITE. FURTHER, IT IS EPA POLICY TO PROTECT FOR MORE THAN HALF THE POPULATION. EPA RISK ASSESSMENT GUIDANCE

FOR SUPERFUND (DATED JULY, 1989) CLEARLY SUGGESTS THE USE OF THE 95 PERCENT UPPER CONFIDENCE LIMIT ON THE DATA. IT IS CLEAR THAT THE ESTIMATE OR SOIL INGESTION USED BY THE AGENCY IN THE ENDANGERMENT ASSESSMENT IS NEITHER UNREASONABLE NOR UNSCIENTIFIC" AS SUGGESTED BY HOMESTAKE. THE ABOVE DISCUSSION DOES NOT ACCOUNT FOR THE CHILD EXHIBITING PICA WHO WOULD BE EXPECTED TO OCCUPY THE EXTREME TAIL OF A SKEWED DISTRIBUTION AND HENCE BE AT GREATLY INCREASED RISK.

COMMENT #6: HOMESTAKE COMMENTED THAT THE CANCER POTENCY FACTOR (1.75 MG/KG-DAY)8 USED BY EPA IN THEIR ENDANGERMENT ASSESSMENT IS BASED ON EPIDEMIOLOGICAL DATA FROM A STUDY OF TAIWANESE POPULATIONS. THE SCIENCE ADVISORY BOARD IS REVIEWING THE TAIWANESE STUDY IN COMPARISON WITH STUDIES IN THE UNITED STATES POPULATIONS AND SUGGESTS OTHER MODELS MIGHT BE MORE APPROPRIATE. HOMESTAKE STATED THAT USE OF THIS FACTOR GROSSLY OVERESTIMATES RISK OF CANCER FROM ARSENIC AT THE WHITEWOOD CREEK SITE.

EPA RESPONSE: THE RESULTS OF THE TAIWANESE STUDY HAVE BEEN BOTH CONFIRMED AND DUPLICATED IN STUDIES CONDUCTED IN CHILE, ARGENTINA, AND MEXICO (BORGONO AND GREIBER, 1972; BERGOGLIO, 1964; CERBRIAN ET AL., 1983). THE STUDIES CONDUCTED IN THE UNITED STATES DO NOT IN ANY WAY CONTRADICT THE EVIDENCE OBTAINED IN THE TAIWANESE STUDY (MORTON ET AL., 1976; SOUTHWICK ET AL., 1981). SAMPLE SIZE OF THE US STUDIES WERE OF INSUFFICIENT STATISTICAL POWER TO USE OR EXTRAPOLATION. FURTHER, THE TREMENDOUS SIZE AND STABILITY OF THE COHORT USED IN THE TAIWANESE STUDY PROVIDE FOR SOME OF THE STRONGEST EVIDENCE OF HUMAN CARCINOGENICITY USED BY EPA.

ARSENIC IS REGARDED AS AN "A" KNOWN HUMAN CARCINOGEN. THIS CLASSIFICATION FOLLOWS COMPREHENSIVE REVIEW OF THE QUALITY OF THE EVIDENCE FOR CARCINOGENITY AND REFLECTS THE REVIEWERS' CONFIDENCE IN THE OVERALL DATA USED TO DERIVE THE SLOPE FACTOR FOR ARSENIC.

COMMENT #7: EPA USED A 70-YEAR LIFETIME AS8THE TOTAL EXPOSURE TIME FOR RESIDENTIAL SCENARIOS IN THEIR ENDANGERMENT ASSESSMENT. HOMESTAKE COMMENTED THAT USE OF NUMBERS FROM EPA'S EXPOSURE FACTORS HANDBOOK (1989) WOULD PRESENT A "REASONABLE WORST CASE ASSUMPTION. THIS HANDBOOK STATES THAT NINE YEARS IS THE AVERAGE LENGTH OF TIME THAT A PERSON RESIDES AT ONE LOCATION DURING A LIFETIME AND THIRTY YEARS IS THE REASONABLE WORST CASE.

EPA RESPONSE: IT APPEARS THAT THE HOMESTAKE REVIEWER MISINTERPRETED THE TOTAL EXPOSURE TIME USED IN EPA'S EA CALCULATIONS. THE VALUE FOR DURATION OF EXPOSURE USED IN EPA'S ENDANGERMENT ASSESSMENT FOR WHITEWOOD CREEK WAS IN FACT 30 YEARS. THIS VALUE REPRESENTS THE 90TH PERCENTILE FOR TIME SPENT AT ONE RESIDENCE IN THE IN US (EPA,1989). IN THE CALCULATION OF CARCINOGENIC RISKS, THE DURATION OF EXPOSURE WAS DIVIDED BY A VALUE REPRESENTING A 70 YEAR (AVERAGE) LIFETIME. THIS PROCEDURE RESULTS IN A VALUE FOR AVERAGE LIFETIME EXPOSURE BASED UPON A 30 YEAR DURATION OF EXPOSURE. FOR NON-CARCINOGENIC EFFECTS, WE ARE INTERESTED IN EVALUATING HEALTH EFFECTS DUE TO CHRONIC, BUT NOT NECESSARILY LIFETIME EXPOSURES (EPA CONSIDERS A CHRONIC EXPOSURE TO BE AN EXPOSURE LASTING AT LEAST 7 YEARS AND UP TO A LIFETIME (70 YEARS)). THEREFORE IN THE CASE OF THE HI CALCULATION, THE EXPOSURE OCCURRING OVER 30 YEARS WHICH IS CONSIDERED TO BE A CHRONIC EXPOSURE, IS "AVERAGED OUT" OVER A 70-YEAR LIFETIME.

COMMENT #8: HOMESTAKE COMMENTED THAT EPA USED AN ABSORPTION RATE OF 80 PERCENT IN THEIR ENDANGERMENT ASSESSMENT. HOMESTAKE PROPOSES THAT THIS IS BASED ON A FORM OF ARSENIC NOT LIKE

THAT FOUND AT WHITEWOOD CREEK. HOMESTAKE PROPOSED ADDITIONAL STUDIES.

EPA RESPONSE: ESTIMATES OF ARSENIC ABSORPTION ARE BASED ON STUDIES CONDUCTED BY VAHTER AND NORIN (1980) AND TAM ET AL. (1979). THESE STUDIES SHOW NEARLY COMPLETE ABSORPTION OF TRI- AND PENTAVALENT ARSENIC.

HOMESTAKE SUPPORTS THE USE OF PRELIMINARY LEACHING STUDIES WHICH INDICATE THAT SOIL ARSENIC AT THE WHITEWOOD CREEK SITE IS "TIGHTLY BOUND" AND HENCE LESS BIOAVAILABILITY. EPA RECOGNIZES THE POSSIBILITY THAT FORMS OF ARSENIC FOUND AT THE SITE MAY DIFFER SLIGHTLY FROM THOSE USED IN THE ABOVE CITED STUDIES. THE AGENCY WOULD SUPPORT A COMPREHENSIVE ABSORPTION STUDY FUNDED BY HOMESTAKE TO DETERMINE THE BIOAVAILABILITY OF SOIL ARSENIC AT THE WHITEWOOD CREEK SITE. SUCH A STUDY MUST BE DESIGNED TO DEFINE THE ABSORPTION AND EXCRETION KINETICS OF SOIL ARSENIC FOUND IN PARTICULATES LESS THAN 150 URN IN DIAMETER. THE STUDY MUST BE CONDUCTED IN AN ANIMAL SPECIES WHOSE DIGESTIVE ANATOMY AND PHYSIOLOGY IS COMPARABLE TO HUMANS AND PROVIDE FOR ADEQUATE MASS BALANCE DETERMINATION. SUCH A STUDY WOULD BE MOST USEFUL IF DESIGNED IN COOPERATION WITH AN EPA TOXICOLOGIST.

EPA WILL NOT ACCEPT PRELIMINARY BENCHTOP GEOCHEMISTRY EXPERIMENTS AS ADEQUATE FOR DETERMINATION OF BIOAVAILABILITY IN LIEU OF PEER REVIEWED, WIDELY ACCEPTED LITERATURE WHICH STRONGLY SUGGESTS OTHERWISE.

COMMENT #9: HOMESTAKE COMMENTED THAT EPA IGNORED FINDINGS BY ITS OWN SCIENCE ADVISORY BOARD THAT HUMANS EFFECTIVELY DETOXIFY AND EXCRETE ARSENIC THAT IS INGESTED AT OR BELOW THE RATE OF 250 MICROGRAMS PER DAY. HOMESTAKE STATED THAT EPA DID NOT CONSIDER DETOXIFICATION OF ARSENIC BY THE HUMAN BODY IN THEIR ENDANGERMENT ASSESSMENT. HOMESTAKE CONTENDS SOME STUDIES SHOW THAT AT A LOW DOSE (LESS THAN 250 MG/DAY), 80 TO 90 PERCENT OF INGESTED AND ABSORBED ARSENIC IS DETOXIFIED AND EXCRETED. HOMESTAKE FEELS AN 80 PERCENT FACTOR SHOULD BE INCORPORATED INTO THE DOSE CALCULATIONS.

EPA RESPONSE: OFFICIAL EPA POLICY REGARDING ARSENIC IS CLEARLY DEFINED IN THE DOCUMENT TITLED SPECIAL REPORT OF INORGANIC ARSENIC: SKIN CANCER: NUTRITIONAL ESSENTIALITY (1987) PREPARED BY THE RISK ASSESSMENT FORUM. THIS REPORT HAS BEE REVIEWED AND APPROVED BY THE SCIENCE ADVISORY BOARD. HOMESTAKE HAS APPARENTLY MISTAKEN TH SUBCOMMITTEE LETTER (SEPTEMBER 28, 1989) OFFICIAL AGENCY POLICY

THE ARGUMENT POSED BY HOMESTAKE THAT EPA DID NOT CONSIDER "DETOXIFICATION'' OF ARSENIC IN EPA'S ENDANGERMENT ASSESSMENT IS ILL FOUNDED. THE ASSUMPTION THAT METHYLATION OF ARSENIC CONSTITUTES DETOXIFICATION REMAINS UNPROVEN. THE DRINKING WATER SUBCOMMITTEE OF THE SCIENCE ADVISORY BOARD IDENTIFIED METHYLATION AS A POSSIBLE DETOXIFICATION MECHANISM. INDEED, METHYLATION OF ARSENIC MAY CONSTITUTE ACTIVATION. SINCE THERE IS NO ANIMAL MODEL WITH WHICH TO TEST THE HYPOTHESIS THAT THE METHYLATED DERIVATIVE OF ARSENIC IS MORE OR LESS CARCINOGENIC THAN ANY OTHER FORM OF ARSENIC, THE CARCINOGENIC POTENTIAL OF ARSENIC IS BEST ESTIMATED FROM THE ABUNDANCE OF HUMAN EVIDENCE NOW AVAILABLE.

COMMENT #10: HOMESTAKE COMMENTED THAT THE SURFACE WATER OF WHITEWOOD CREEK IS NOT PRESENTLY USED FOR DRINKING WATER, AND DOES NOT POSE A THREAT TO HUMAN HEALTH OR THE ENVIRONMENT. THEREFORE, THERE IS NO NEED FOR FURTHER SAMPLING OF THE CREEK. THEIR CONCLUSIONS ARE BASED ON US GEOLOGICAL SURVEY MONITORING DATA, THE CHERRY REPORT AND PROPOSED REMEDIAL ACTIONS.

EPA RESPONSE: EPA IS REQUIRING ADDITIONAL SURFACE WATER MONITORING IN WHITEWOOD CREEK DUE TO THE CONCERN OVER POTENTIAL FOR FUTURE WATER QUALITY DEGRADATION AS A RESULT OF EROSION OF THE TAILINGS RESULTING FROM HIGH PRECIPITATION EVENTS AND CHANGES IN THE COURSE OF THE STREAM (SEE RESPONSE TO HOMESTAKE COMMENT NO. 2).

COMMENT #11: HOMESTAKE QUESTIONED THE EFFECTIVENESS OF WARNING SIGNS IN RESTRICTING ACCESS TO THE TAILINGS AREA.

EPA RESPONSE: AS DISCUSSED EARLIER, EPA HAS RE-EVALUATED ITS POSITION BASED ON COMMENTS BY HOMESTAKE AND SITE RESIDENTS AT THE PUBLIC MEETING. IN RESPONSE TO THESE CONCERNS, WARNING SIGNS HAVE NOT BEEN INCORPORATED IN EPA'S SELECTED REMEDY.

COMMENT #12: HOMESTAKE COMMENTED THAT THE PROPERTY OWNERS SHOULD BE RESPONSIBLE FOR REMEDIATION OF AREAS WHERE FUTURE DEVELOPMENT IS ALLOWED.

EPA RESPONSE: EPA ACCEPTS THIS COMMENT FOR CONSIDERATION DURING THE REMEDIAL DESIGN/REMEDIAL ACTION NEGOTIATION PHASE OF THIS PROJECT.

COMMENT #13: HOMESTAKE COMMENTED THAT COMMERCIAL DEVELOPMENT SHOULD BE ALLOWED WITHIN THE 100-YEAR FLOODPLAIN BUT OUTSIDE THE TAILINGS AREA.

EPA RESPONSE: EPA CONCURS WITH THIS COMMENT UNLESS CONCENTRATIONS WITHIN THIS AREA EXCEED THE LEVEL OF ARSENIC IN SOILS ASSOCIATED WITH PUBLIC HEALTH RISK.

COMMENT #14: HOMESTAKE RECOMMENDED THAT BOTH PRE-IMPLEMENTATION AND VERIFICATION SAMPLING BE CONFINED TO THE SURF ACE. THEY FURTHER STATED THAT SOIL SAMPLING IS NOT NECESSARY TO DEFINE THE LIMITS OF THE 100-YEAR FLOODPLAIN.

EPA RESPONSE: IT IS EPA'S POSITION THAT ANY SURFACE SOIL (UP TO THE DEPTH OF DISTURBANCE BY PLANT OR ANIMAL MECHANISMS) WITH ARSENIC CONCENTRATIONS ABOVE THE ACTION LEVEL POSES POTENTIAL RISK TO SITE RESIDENTS. AS A RESULT, EPA IS REQUIRING 12 INCHES OF COVER IN THE RESIDENTIAL AREAS AND 24 INCHES IN GARDEN AREAS. IN ORDER TO ASSURE THAT SUFFICIENT COVER HAS BEEN ADDED AND THE COVER HAS NOT BEEN SIGNIFICANTLY DISTURBED SUBSEQUENT TO REMEDIATION, IT IS EPA'S POSITION THAT SAMPLING AT DEPTH IS REQUIRED.

EPA REQUIRES THAT FURTHER DELINEATION OF THE WHITEWOOD CREEK 100-YEAR FLOODPLAIN BE CONDUCTED TO SPECIFICALLY DOCUMENT THE AREAS REGULATED UNDER THE PROPOSED COUNTY ORDINANCES.

COMMENT #15: HOMESTAKE COMMENTED THAT BASED ON EPA'S ENDANGERMENT ASSESSMENT, THE ENVIRON REPORT AND THE INTAKE SURVEY BY GEOCHEMICAL ENGINEERING INC., THERE DOES NOT APPEAR TO BE SUFFICIENT INDICATION OF SUBSTANTIAL ARSENIC UPTAKE THROUGH THE FOOD CHAIN TO WARRANT FURTHER INVESTIGATION.

EPA RESPONSE: BASED ON CURRENT INFORMATION, EPA CONCURS WITH THIS COMMENT.

#TA

TABLE A-1
MAXIMUM CONCENTRATIONS OF CONTAMINANTS IN AFFECTED MEDIA
WHITEWOOD CREEK, SOUTH DAKOTA

	TAILINGS MG/KG	ALLUVIUM MG/KG
ARSENIC	42,500	700
CADMIUM	180	14
CHROMIUM	41	22
COPPER	246	104
IRON	136,000	75,000
LEAD	48	24
MANGANESE	8,000	5,030
MERCURY	5.9	1.5
NICKEL	2,050	33
SELENIUM	10	2
SILVER	2.2	4.9
SULFATE	145,000	3,800
ZINC	136	116
CYANIDE	NM	NM

	IRRIGATED SOILS MG/KG	RESIDENTIAL SOILS MG/KG
ARSENIC	600	2,400
CADMIUM	7.4	1.2
CHROMIUM	48	NM
COPPER	660	NM
IRON	58,000	NM
LEAD	25	NM
MANGANESE	1,450	NM
MERCURY	0.14	0.138
NICKEL	44	NM
SELENIUM	ND	ND
SILVER	0.7	NM
SULFATE	8,400	NM
ZINC	159	NM
CYANIDE	NM	NM

	GROUND WATER MG/L	SURFACE WATER MG/L
ARSENIC	0.780	0.200
CADMIUM	0.029	0.010
CHROMIUM	0.019	0.020
COPPER	0.032	0.060
IRON	316	0.850
LEAD	0.10	0.002
MANGANESE	29	0.310
MERCURY	ND	0.0003
NICKEL	0.330	NM
SELENIUM	0.079	0.003
SILVER	0.004	0.001
SULFATE	4,800	NM
ZINC	2.20	NM
CYANIDE	0.050	0.030

	NATURAL VEGETATION MG/KG	IRRIGATED CROPS MG/KG
ARSENIC	240	1.8
CADMIUM	3.7	16
CHROMIUM	58	8.2
COPPER	30	22
IRON	9,250	483
LEAD	ND	ND
MANGANESE	1,500	68
MERCURY	0.105	0.075
NICKEL	32	22
SELENIUM	1.2	0.5
SILVER	1.3	0.21
SULFATE	NM	NM
ZINC	313	52
CYANIDE	NM	NM

ND = NOT DETECTED
NM = NOT MEASURED
SOURCE : WHITEWOOD CREAK STUDY, 1984 , FOX CONSULTANTS, INC
FEASIBILITY STUDY FOR WHITEWOOD CREEK, S.D., CERCLA SITE,
1989,ICF TECHNOLOGY INCORPORATED

TABLE A-2
AVERAGE CONCENTRATIONS OF
CONTAMINANTS IN VARIOUS MEDIA

GROUNDWATER (MG/L)

CONTAMINANT	UPGRADIENT	DOWNGRADIENT
ARSENIC	0.009	0.21
CADMIUM	0.004	0.003
CHROMIUM	0.008	0.005
COPPER	0.11	0.002
LEAD	0.019	0.025
MANGANESE	0.015	1.6
MERCURY	0.0003	0.0004
NICKEL	0.01	0.01

SOIL (MG/KG)

CONTAMINANT	IRRIGATED CROPLAND	TAILINGS
ARSENIC	99	2,116
CADMIUM	2.1	14
CHROMIUM	26	29
COPPER	48	49
LEAD	19	37
MANGANESE	575	1,816
MERCURY	0.065	1.63
NICKEL	26	23

SOIL (MG/KG)

CONTAMINANT	RESIDENCE (YARD)
ARSENIC	166
CADMIUM	0.90
CHROMIUM	26
COPPER	48
LEAD	19
MANGANESE	575
MERCURY	0.084
NICKEL	26

SOURCE : FINAL ENDANGERMENT ASSESSMENT SUMMARY DOCUMENT, 1989 EPA (JACOBS)

TABLE A-3
POTENTIAL LIFETIME CANCER RISK FOR EXPOSURE TO ARSENIC
VIA THE SOIL AND GROUNDWATER INGESTION PATHWAYS

SCENARIO	ARSENIC RISK GROUNDWATER	SOIL
REPRESENTATIVE SITE RESIDENT	1.9 X (10-4)	2.4 X (10-4)
MAXIMUM EXPOSED SITE RESIDENT	4.4 X (10-3)	2.6 X (10-3)
RECREATIONAL VISITOR		8.2 X (10-5)

SCENARIO	ARSENIC RISK TOTAL
REPRESENTATIVE SITE RESIDENT	4.3 X (10-4)
MAXIMUM EXPOSED SITE RESIDENT	7.0 X (10-3)
RECREATIONAL VISITOR	8.2 X (10-5)

TABLE A-4
HAZARD INDICES DUE TO EXPOSURE TO CONTAMINANTS OF CONCERN
VIA THE SOIL AND GROUNDWATER INGESTION PATHWAYS

SCENARIO	TOTAL HAZARD INDEX GROUNDWATER	SOIL
REPRESENTATIVE SITE RESIDENT	0.54	0.14
MAXIMUM EXPOSED SITE RESIDENT	3.8	1.1
RECREATIONAL VISITOR	N/A	0.05

SCENARIO	TOTAL HAZARD INDEX TOTAL
REPRESENTATIVE SITE RESIDENT	0.7
MAXIMUM EXPOSED SITE RESIDENT	4.9
RECREATIONAL VISITOR	0.05
REPRESENTATIVE CHILD RESIDENT	1.0

1. UPGRADIENT AND DOWNGRADIENT GROUNDWATER INGESTION RATES VARY BY SCENARIO. SEE TEXT AND APPENDIX A FOR EXPLANATION.

2. TAILINGS DEPOSIT SOILS, IRRIGATED CROPLAND SOIL AND RESIDENTIAL SOIL INGESTION RATES VARY BY SCENARIO. SE TEXT AND APPENDIX A FOR EXPLANATION.

TABLE A-5
REMEDIAL ALTERNATIVES FOR WHITEWOOD CREEK

ALTERNATIVE 1:	NO ACTION
ALTERNATIVE 2:	INSTITUTIONAL CONTROLS
ALTERNATIVE 3:	INSTITUTIONAL CONTROLS WITH FENCING OF TAILINGS DEPOSIT AREAS
ALTERNATIVE 4:	INSTITUTIONAL CONTROLS WITH COVERING AND / OR REMOVAL OF SURFACE SOILS OF EXISTING RESIDENTIAL PROPERTIES(A)
ALTERNATIVE 5:	INSTITUTIONAL CONTROLS WITH FENCING OF TAILINGS DEPOSIT AREAS AND COVERING AND / OR REMOVAL OF SURFACE SOILS OF EXISTING RESIDENTIAL PROPERTIES(A)
ALTERNATIVE 6:	INSTITUTIONAL CONTROLS WITH FULL SOIL COVER OF TAILINGS DEPOSIT AREAS AND COVERING AND / OR REMOVAL OF SURFACE SOILS OF EXISTING RESIDENTIAL PROPERTIES
ALTERNATIVE 7:	INSTITUTIONAL CONTROLS WITH PARTIAL SOIL COVER OF TAILING DEPOSIT AREAS AND COVERING AND / OR REMOVAL OF SURFACE SOILS OF EXISTING RESIDENTIAL PROPERTIES
ALTERNATIVE 8:	INSTITUTIONAL CONTROLS WITH REMOVAL OF TAILINGS DEPOSIT AREAS, ON-SITE DISPOSAL OF TAILINGS AND COVERING AND / OR REMOVAL OF SURFACE SOILS OF EXISTING RESIDENTIAL PROPERTIES
ALTERNATIVE 9:	INSTITUTIONAL CONTROLS WITH REMOVAL OF TAILINGS DEPOSIT AND ALLUVIAL TAILINGS FROM TAILINGS DEPOSIT AREAS, ON-SITE DISPOSAL OF TAILING AND COVERING AND / OR REMOVAL OF SURFACE SOILS OF EXISTING RESIDENTIAL PROPERTIES

(A) DURING THE DETAILED ANALYSIS, A SUB-ALTERNATIVE (ALLOWING FOR FUTURE DEVELOPMENT) TO THESE ALTERNATIVES WAS ADDED.

TABLE A-7
ESTIMATED COSTS FOR THE SELECTED REMEDY
INSTITUTIONAL CONTROLS WITH COVERING AND /OR REMOVAL OF
SURFACE SOILS OF EXISTING RESIDENTIAL PROPERTIES
(ALLOWING FOR FUTURE DEVELOPMENT)

ITEM	COST
CAPITAL COSTS:	
DELINEATION OF FLOODPLAIN AND EXTENT OF CONTAMINATION	$175,000
PRE-IMPLEMENTATION SAMPLING OF TWELVE EXISTING AND FIFTEEN FUTURE RESIDENTIAL PROPERTIES	$199,000
REMOVAL, SOIL COVERING AND CONFIRMATION SAMPLING OF RESIDENTIAL PROPERTIES	$604,000
ASSISTING THE COUNTIES IN ADOPTING LAND SAMPLING OF RESIDENTIAL PROPERTIES	$30,000
PERFORMING THE INITIAL EDUCATION PROGRAM	$20,000
REMEDIATE PROPERTIES UNDER VARIANCE	$447,000
TOTAL CAPITAL COSTS	$1,028,000
OPERATION AND MAINTENANCE COSTS	ANNUAL COSTS
RE-SAMPLE EXISTING RESIDENTIAL PROPERTIES IN THE FIFTH YEAR AFTER REMOVAL AND SOIL COVERING AT THESE PROPERTIES ($26,000) DISTRIBUTED OVER FIVE YEAR	$5,000
MAINTENANCE OF THE EDUCATIONAL PROGRAM	$2,000
ANNUAL MONITORING OF WHITEWOOD CREEK	$5,000
TOTAL ANNUAL 0 & M COSTS	
YEAR 1 - 5	$12,000
YEAR 6 - 30	$6,000
TOTAL COSTS (NET PRESENT VALUE CALCULATED USING DISCOUNT OF 5 PERCENT AND 30 YEAR O & M PERIOD)	$882.813

APPENDIX A

INTAKE ASSUMPTIONS FOR EPA'S ENDANGERMENT ASSESSMENT

CONSIDERATION OF THE DIFFERING PHYSICAL CHARACTERISTICS AND BEHAVIOR PATTERNS OF CHILDREN AND ADULTS RESULTS IN SEPARATE INTAKE RATE ESTIMATES FOR THESE TWO AGE GROUPS. THE ESTABLISHMENT OF SEPARATE INTAKE RATES ALLOWS CALCULATION OF RISKS EXPECTED FOR THE SPECIFIC SCENARIOS DESCRIBED IN SECTION V. FOR INSTANCE, THE ESTIMATION OF CHRONIC NON-CARCINOGENIC RISKS CAN BE ACHIEVED FOR BOTH CHILDREN AND ADULTS USING THE INTAKE RATES SPECIFIC TO EACH SUBPOPULATION. ALTERNATIVELY, CARCINOGENIC RISKS, WHICH ARE CALCULATED USING THE AVERAGE CONTAMINANT INTAKE OVER A 70 YEAR LIFETIME, CAN BE ESTIMATED BY CONSIDERING THAT AN INDIVIDUAL LIVING ONSITE COULD EXPERIENCE BOTH THE CHILD AND THE ADULT INTAKE RATES DURING A LIFETIME.

THE DISCUSSION IN THIS SECTION FOCUSES UPON THE SIGNIFICANT REVISIONS TO THE SOIL CONTAMINANT INTAKE EQUATIONS WHICH HAVE BEEN INCORPORATED IN THIS REPORT. FOR THE RURAL RESIDENTIAL SCENARIOS, IT IS ASSUMED THAT SITE SOILS ARE AVAILABLE FOR INGESTION DURING TIMES WHEN THE GROUND IS NOT FROZEN. THE FACTOR 0.667 CORRESPONDS TO THE AVERAGE FRACTION OF A YEAR IN WHICH SOILS IN THE NORTHWESTERN US ARE NOT FROZEN. ALSO FOR THE SOIL INGESTION PATHWAYS, IT IS ASSUMED THAT THE ABSORPTION EFFICIENCY OF ARSENIC FROM SOILS IS EQUIVALENT TO ITS ABSORPTION EFFICIENCY FROM FOODS. THE SOIL INGESTION RATES FOR CHILDREN AND ADULTS ARE 200 MG/DAY AND 100 MG/DAY, RESPECTIVELY. INTAKE PARAMETERS AND EQUATIONS FOR THE SOIL AND GROUNDWATER PATHWAY ARE PRESENTED HERE IN TABLES 1(A) AND 2(A).

TABLE 1(A) INTAKE PARAMETERS FOR SOIL AND GROUNDWATER PATHWAYS

A = ABSORPTION FACTOR FOR CONTAMINANT IN SOIL (0.50 FOR ARSENIC, 1.0 FOR OTHER INDICATOR CONTAMINANTS)

CI = AVERAGE CONCENTRATION OF CONTAMINANT IN IRRIGATED CROPLAND SOIL

CR = AVERAGE CONCENTRATION OF CONTAMINANT IN SOIL AT THE RESIDENCES

CT = AVERAGE CONCENTRATION OF CONTAMINANT IN TAILING SOILS

CW = AVERAGE CONCENTRATION OF CONTAMINANT IN GROUNDWATER

FI = FRACTION OF INGESTED SOIL DERIVED FROM IRRIGATED CROPLAND SOILS (0.1)

FRA = FRACTION OF INGESTED SOIL FOR ADULTS DERIVED FROM SOILS AT RESIDENCE (SAME AS AVERAGE TIME SPENT AT RESIDENCE) (0.65)

FRC = FRACTION OF INGESTED SOIL FOR CHILDREN DERIVED FROM SOILS AT RESIDENCE (SAME AS AVERAGE TIME SPENT AT RESIDENCE) (0.90)

FT = FRACTION OF INGESTED SOIL DERIVED FROM TAILINGS SOIL (0.03)

FY = FRACTION OF YEAR FOR WHICH SOILS ARE AVAILABLE FOR INGESTION (0.667)

IA = SOIL INGESTION RATE FOR ADULTS (100 MG/DAY)

IC = SOIL INGESTION RATE FOR CHILDREN UP TO 6 YEARS (200 MG/DAY)

IW = GROUNDWATER INGESTION RATE (1.075 I/DAY)

NY = NUMBER OF VISITS FOR A RECREATIONAL VISITOR PER LIFETIME (500)

N1 = NUMBER OF DAYS PER 70 YEAR LIFETIME (25550)

WA = AVERAGE BODY WEIGHT FOR ADULTS (70 KG)

WC = AVERAGE BODY WEIGHT FOR CHILDREN UP TO 6 YEARS (17 KG)

TABLE 2(A)

INTAKE EQUATIONS FOR THE SOIL AND GROUNDWATER PATHWAYS

REPRESENTATIVE RURAL RESIDENT

AGE GROUP: 6 - 70 YEARS

INTAKE (SOIL) = (A * FY * 1A/WA) * (FT * CT + FRA* CR + FI * CI)

INTAKE (GROUNDWATER) = (IW * CW)/WA

AGE GROUP: 0-6 YEARS

INTAKE (SOIL) = A * FY * IC * FRC * CR/WC

INTAKE (GROUNDWATER) = (1W * CW)/WC

RECREATIONAL VISITOR

INTAKE (SOIL) = (A * NV * IA * CT)/(WA * N1)

MAXIMUM EXPOSED RURAL RESIDENT

AGE GROUP: 6-70 YEARS

INTAKE (SOIL) = (A * FY * IA * FRA CT)/WA

INTAKE (GROUNDWATER) = (IW * CW)WA

AGE GROUP: 0-6 YEARS

INTAKE (SOIL) = (A * FY * 1C * FRC * CT)/WC

INTAKE (GROUNDWATER) = (IW * CW)/WC

APPENDIX B

HEALTH BASED SOIL ACTION LEVEL FOR ARSENIC AT THE RESIDENCES

A HEALTH BASED SOIL ACTION LEVEL MAY BE DERIVED FOR ARSENIC IN THE DRIVEWAY AND YARD SOILS AT THE RESIDENCES OF THE WHITEWOOD CREEK SITE BY ASSUMING THAT REMEDIAL ACTION EFFORTS AIMED AT GROUNDWATER AND THE TAILINGS AREA ARE IN PLACE. AN ACTION LEVEL DERIVED UNDER THESE CONDITIONS WOULD BE BASED UPON AN ACCEPTABLE INCREMENTAL RISK THAT INDIVIDUALS MAY INCUR BY LIVING AT A SITE RESIDENCE FOR A SPECIFIED NUMBER YEARS OUT OF A 70 YEAR LIFE-TIME.

THE USUAL LEVELS OF REGULATORY CONCERN SPAN THE RANGE OF (10-4) TO (10-7) (USEPA 1986).

HOWEVER, NATURALLY OCCURRING ARSENIC CONCENTRATIONS FOUND IN SOILS AND WATER RESULT IN A RISK LEVEL OF (10-4). FURTHERMORE, REGULATIONS PERTAINING TO ARSENIC RESULT IN (10-3) RISK AS AN ACCEPTABLE TARGET RISK (E.G. A RISK LEVEL OF (10-3) RESULTS FROM THE ARSENIC MCL OF 0.05 MG/L). AN ACCEPTABLE RISK LEVEL OR ARSENIC INTAKE VIA DRIVEWAY AND YARD SOIL INGESTION COULD BE 10-(4) IF THE RISK DUE TO TOTAL ARSENIC INTAKE DOES NOT EXCEED THE 10-(3) LEVEL.

THE FOLLOWING EQUATION, BASED UPON THE REPRESENTATIVE RURAL RESIDENT SOIL INTAKE EQUATIONS 1 TABLE 2(A) OF THIS REPORT) AND THE REPRESENTATIVE ADULT RURAL RESIDENT EXPOSURE SCENARIO (SECTION V OF THIS REPORT), HAS BEEN USED TO CALCULATE AN ACTION LEVEL FOR ARSENIC UNDER THE ASSUMPTION THAT (10-4) REPRESENTS AN ACCEPTABLE INCREMENTAL ARSENIC RISK INCURRED BY AN INDIVIDUAL LIVING ONSITE:

$$C = CPF * A * FY \{(DA * IA * FRA)/WA + (DC * IC * FRC)/WC\}^{TR/}$$

WHERE:

CPF = CARCINOGENIC POTENCY FACTOR (1.75 {MG/KG-DAY}(1);

DC = EXPOSURE DURATION FRACTION FOR INDIVIDUALS UP TO 6 YEARS ASSUMING 6 YEARS OF EXPOSURE DURING A 70 YEAR LIFETIME (0.0857);

DA = EXPOSURE DURATION FRACTION FOR INDIVIDUALS FROM 6-70 YEARS ASSUMING 9 TO 30 YEARS OF EXPOSURE DURING A 70 YEAR LIFETIME (0.13 OR 0.43);

TR = TARGET RISK OF (10-4)

AND WHERE THE REST OF THE INTAKE PARAMETERS ARE GIVEN IN APPENDIX A, TABLE 1 OF THIS REPORT.

TWO VALUES HAVE BEEN CHOSEN FOR DA EXPOSURE DURATION FRACTION FOR ADULTS, BASED UPON THE ESTIMATED VARIATION IN VALUES OF DA ACROSS THE NATION (SCHAUM 1989). THIS RESULTS IN A RANGE OF TARGET CONCENTRATIONS. IT SHOULD BE NOTED THAT THE INHERENT VARIABILITY OF THE OTHER PARAMETERS IN THIS EQUATIONS CAN ALSO ADD TO THE RANGE OF VARIABILITY THAT WOULD BE EXPECTED IN THE CALCULATION OF ARSENIC ACTION LEVELS AT THE SITE.

SUBSTITUTING THE INPUT PARAMETERS AND SOLVING THE EQUATION FOR BOTH VALUES OF DA GIVES A RANGE OF 82 TO 104 PPM AS AN ACTION LEVEL FOR ARSENIC.

APPENDIX C

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR WHITEWOOD CREEK SUPERFUND SITE

FEDERAL AND STATE REQUIREMENTS, WHICH ARE EITHER APPLICABLE OR RELEVANT AND APPROPRIATE TO THE WHITEWOOD CREEK SUPERFUND SITE AND TO REMEDIAL ACTIONS RECOMMENDED AT THIS SITE IN THE RECORD OF DECISION, ARE LISTED BELOW. THESE REQUIREMENTS ARE ALSO DISCUSSED IN RELATIONSHIP TO SITE CONDITIONS ANTICIPATED FOLLOWING REMEDIAL ACTIVITIES.

STANDARD, REQUIREMENT CRITERIA OR GUIDELINE	ARAR?
CHEMICAL SPECIFIC-FEDERAL	
NATIONAL PRIMARY DRINKING WATER STANDARDS,40 CFR PART 141, ESTABLISHES MAXIMUM CONTAMINANT LEVELS FOR COMMUNITY WATER SUPPLY SYSTEMS.	YES

COMMENT

ALTHOUGH THESE STANDARDS ARE NOT APPLICABLE BECAUSE THEY APPLY TO COMMUNITY WATER SUPPLY SYSTEMS, THEY ARE DEEMED TO RELEVANT AND APPROPRIATE TO THE DOWNGRADIENT ALLUVIAL GROUNDWATERS OF WHITEWOOD CREEK. IF THESE WATERS ARE EVER USED FOR WATER SUPPLY, IT IS UNLIKELY THAT THEY WOULD BE TREATED BEFORE USE. THESE ARARS WOULD NOT BE MET FOR GROUNDWATER FOLLOWING IMPLEMENTATION OF THE SELECTED REMEDY. A WAIVER IS NECESSARY BECAUSE OF THE POTENTIAL FOR INCREASE IN RISK TO PUBLIC HEALTH AND BECAUSE OF THE TECHNICAL IMPRACTICALITY OF MEETING THIS ARAR (SEE SECTION VII).

WATER QUALITY CRITERIA, 40 CFR PART 131: ESTABLISHES CRITERIA FOR THE PROTECTION OF AQUATIC LIFE AND THE PROTECTION OF HUMAN HEALTH THROUGH THE CONSUMPTION OF FISH AND WATER.	YES

COMMENTS

THESE CRITERIA ARE NOT APPLICABLE TO SURFACE WATER BECAUSE THEY ARE NOT ENFORCEABLE STANDARDS. HOWEVER, THEY MAN BE RELEVANT AND APPROPRIATE UNDER CERCLA SECTION 121 (D) (2) (A). THE CRITERIA FOR THE PROTECTION OF HUMAN HEALTH FROM THE CONSUMPTION OF FISH IS RELEVANT AND APPROPRIATE AS WHITEWOOD CREEK IS DESIGNATED FOR USE AS A FISHERY IN THE SOUTH DAKOTA WATER QUALITY STANDARDS. THE CRITERIA FOR THE PROTECTION OF AQUATIC LIFE ARE RELEVANT AND APPROPRIATE EXCEPT FOR THE CRITERIA INCLUDED IN SOUTH DAKOTA WATER QUALITY STANDARDS. THESE ARARS WOULD NOT BE MET AS THE WATER ENTERING THE SITE DOES NOT MEET THESE CRITERIA.

NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS. 40, CFR PART 50: ESTABLISHES STANDARDS FOR AMBIENT AIR QUALITY TO PROTECT	YES

COMMENTS

THESE STANDARDS ARE APPLICABLE. THERE IS NO KNOW EXCEEDANCE OF THESE STANDARDS AT THIS TIME. THESE STANDARDS MAY NOT BE ATTAINED DURING BRIEF TIMES WHILE THE SELECTED REMEDY IS BEING IMPLEMENTED. MEASURES CAN BE TAKEN TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT DURING THIS PROCESS.

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENT FOR
WHITEWOOD CREEK SUPERFUND SITE

STANDARD, REQUIREMENT CRITERIA OR GUIDELINE	ARAR?
CHEMICAL SPECIFIC-STATE	
GROUNDWATER QUALITY STANDARDS, ARSD 74:03:15: ESTABLISHES MAXIMUM CONCENTRATION LIMITS FOR GROUNDWATERS.	YES
COMMENT	
THESE STANDARDS ARE APPLICABLE	
SURFACE WATER QUALITY STANDARDS, ARSD 74:03:02: ESTABLISHES WATER QUALITY STANDARDS FOR WHITEWOOD CREEK.	YES
COMMENT	
THESE STANDARDS ARE APPLICABLE	
AMBIENT AIR QUALITY STANDARDS, ARSD 74:26:02:04 AND ARSD 74:26:02:35: ESTABLISHES AMBIENT AIR QUALITY STANDARDS FOR PARTICULATE MATTER.	YES
COMMENT	
THESE STANDARDS ARE APPLICABLE	
DRINKING WATER STANDARD ARSD 74:04:05: ESTABLISHES MCLS FOR PUBLIC WATER SYSTEM	YES
COMMENT	
THESE STANDARDS ARE AS STRINGENT AS NATIONAL PRIMARY DRINKING WATER STANDARDS. THEY ARE RELEVANT AND APPROPRIATE TO GROUND WATER FOR REASONS DISCUSSED UNDER NATIONAL DRINKING WATER STANDARDS.	
LOCATION SPECIFIC-FEDERAL	
ARCHAEOLOGICAL AND HISTORIC PRESERVATION ACT, 40 CFR SECTION 6.301(C): ESTABLISHES PROCEDURE TO PROVIDE FOR PRESERVATION OF HISTORICAL AND ARCHAEOLOGICAL DATA WHICH MIGHT BE DESTROYED THROUGH ALTERATION OF TERRAIN.	YES
COMMENT	
THIS REQUIREMENT MIGHT BE APPLICABLE TO THOSE REMEDIAL ACTIONS (SUCH AS THE REMOVAL OF TAILINGS FROM THE TAILINGS DEPOSIT AREAS) WHICH WOULD INVOLVE THE ALTERATION OF TERRAIN. DETERMINATIONS OF ITS APPLICABILITY WILL BE MADE IN THE DESIGN OF REMEDIAL ACTIONS.	

NATIONAL HISTORIC PRESERVATION ACT,40 CFR SECTION 6.301(B) REQUIRES CONSIDERATION OF THE EFFECT ON ANY DISTRICT, SITE BUILDING. STRUCTURE OR OBJECT THAT IS INCLUDED IN OR ELIGIBLE FOR INCLUSION IN THE NATIONAL REGISTER OF HISTORIC PLACES. YES

COMMENT

SAME AS ABOVE

HISTORIC SITES, BUILDINGS AND ANTIQUITIES ACT, 40 CFR SECTION 6.301(A): REQUIRES CONSIDERATION OF THE EXISTENCE AND LOCATION OF LANDMARKS ON THE NATIONAL REGISTRY OF NATURAL LANDMARKS TO AVOID UNDESIRABLE IMPACTS ON SUCH LANDMARKS. YES

COMMENT

SAME AS ABOVE